Heating and Ventilating

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

Volume 30 AUGUST, 1933 Number 8

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THIS MONTH'S COVER

The new headquarters of the Metropolitan Life Insurance Co., New York, shown on the cover, is one of the most completely air conditioned buildings in the world, 31 stories with over 6 million cubic feet of space being conditioned. Clyde R. Place was the consulting engineer on mechanical equipment; Starrett Bros. and Eken, the builders; Baker Smith and Company, the heating contractors, and Wade and Corbett, the architects.

Published Monthly by

THE INDUSTRIAL PRESS, 148 LAFAYETTE STREET, NEW YORK

ROBERT B. LUCHARS, President — EDGAR A. BECKER, Vice-Pres. and Treasurer — ERIK OBERG, Secretary

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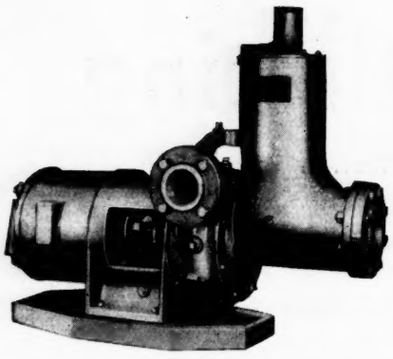
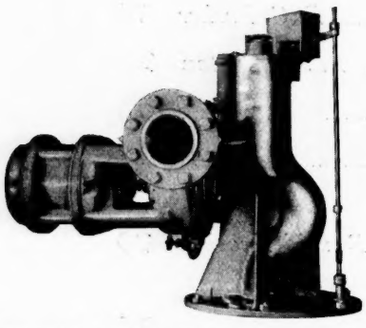
Subscription, $2 per year in United States and Mexico. $2.50 in Canada. $3 all other countries. Single copies regular issue, 30 cents; special issues, $1.



JENNINGS SUMP AND SEWAGE PUMPS

STANDARD TYPE

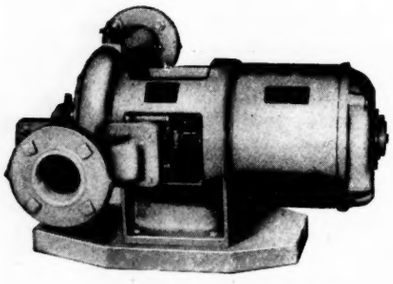
For mounting at or away from the pit cover. Working parts entirely above the cover. Only suction pipe submerged.



JENNINGS SUMP AND SEWAGE PUMPS

PEDESTAL TYPE

Mounted entirely above the pit cover. Entirely self-priming. All working parts high and dry. Only suction pipe submerged. Economical.



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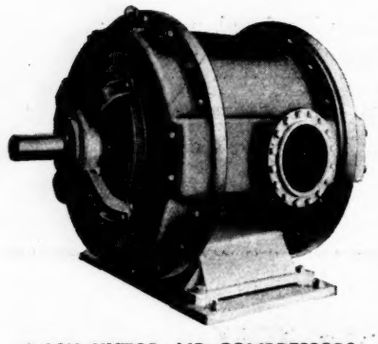

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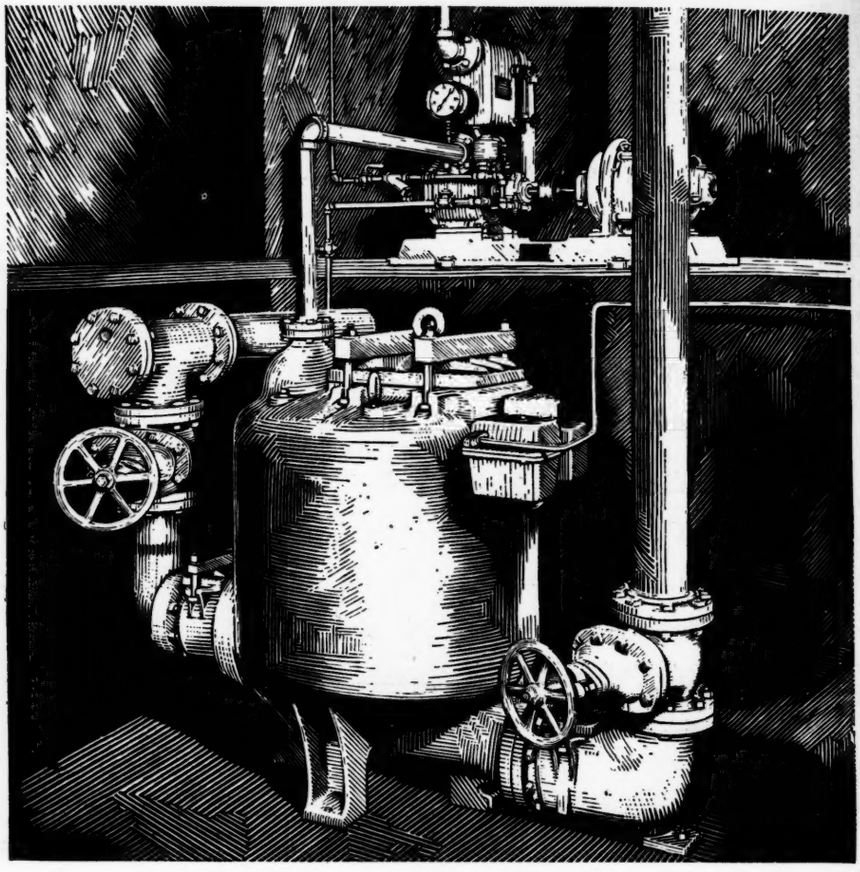

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Application of Calcium Chloride Brine to Air Conditioning

By GEORGE T. CONDRON†

WHILE the application of hygroscopic solutions (such as calcium chloride brine) to air conditioning in connection with the control of humidity has been contemplated in a number of patents, the actual development of commercial applications has been practically non-existent. However, with the present demand for economy, this method of humidity control is again attracting attention, for it possesses the following advantages:

1. Dehumidification by absorption (reducing heat quantities involved and eliminating reheating).
2. Humidification by vaporization of water from the solution (a possibility frequently overlooked).
3. Washing without affecting the humidity.
4. Use of higher temperature cooling mediums, since it is not necessary to chill to the dewpoint.
5. No sweating of cooling coils.
6. Simplicity of apparatus and controls.

An apparatus for the application of this system is shown schematically in Fig. 1. It consists of a brine washer, brine reservoir, brine cooler, brine concentrator, a city water connection to the brine reservoir for diluting, and a double circuit humidistat controlling the supply of heat to the concentrator and the addition of water for diluting to control the humidity; a fin-type coil for cooling or heating connected with a source of cooling water for summer and heating water for winter, thermostat governing the flow of the cooling and heating water for temperature control; a filter for air cleaning, and the usual fan and air ducts.

The double circuit humidistat closes the low humidity circuit at 40% relative humidity or lower (opening the diluting water valve) and holds this circuit until the relative humidity reaches 47%, this circuit being open at all relative humidities above 47%. It closes the high humidity circuit at 55% relative humidity (supplying heat to the concentrator) and holds this circuit until the relative humidity is reduced to 50%, this circuit being open at all relative humidities below 50%.

The thermostat is also a double circuit instrument. The heating circuit operates at 70°. It governs the supply of heat to the fin-type coil, shown in Fig. 1, as operating a valve to control the flow of hot water, although this circuit might just as well control the operation of a boiler. The cooling circuit operates at 75° or higher (being reset manually for the desired temperature depression). It controls the supply of cooling water to the fin-type coil.

The versatility of this system is best illustrated by brief outlines of its operation under certain representative conditions. In these cases the heat and humidity gains in the space will be neglected for the sake of simplicity since their only effect will be to lower the temperature and humidity of the end-points. Fig. 2 (Diagrams A, B, C, and D) will assist in visualizing the processes. The vertical axis is graduated for the temperature in degrees and the horizontal axis for relative humidity in per cent. The dot-dash lines indicate the relations at constant absolute humidity and the dotted lines indicate the relations for adiabatic humidification or dehumidification with pure water; that is, the transfer of sensible heat of the air to heat of vaporization of the moisture during humidification, without heating or cooling from any external source.

The conditioning from A to A′ (Diagram A, Fig. 2) is by evaporative cooling along the indicated adiabatic lines; the slope differs slightly from that of pure water because of the *heat of solution.* In such a case the cooling in the fin-type coil will be unnecessary and will be discontinued by the thermostat once the initial cooling-off period has passed. The humidistat, through the low humidity circuit, will govern the addition of water to the brine so as to maintain the proper strength

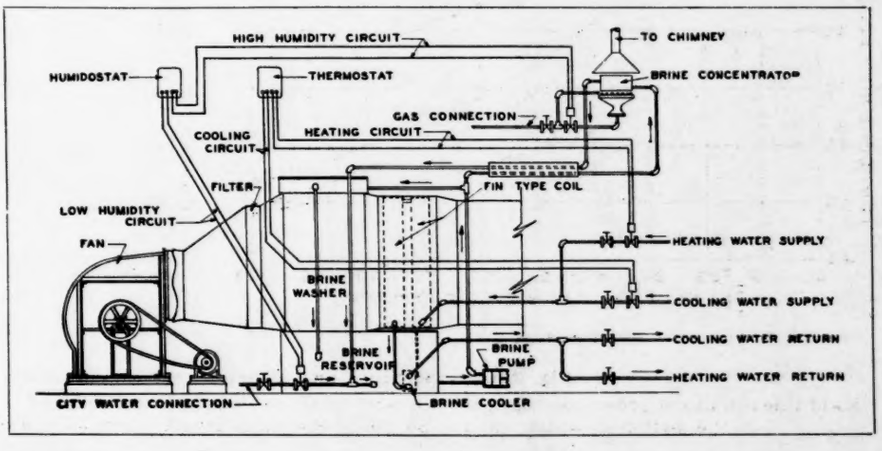

Fig. 1. Air conditioning apparatus using calcium chloride brine for humidity control

†Mechanical Engineer, Chicago.

of the brine solution. This same process, which is the most economical method of cooling, can be employed when using a water washer (the usual type of air washer) without refrigeration, but is not possible through the use of a solid absorbing agent (such as silica gel) or by a cooling coil alone.

The conditioning from B to B′ (Diagram A, Fig. 2) is along a line of constant absolute humidity. It is accomplished entirely in the fin-type coil once the strength of the brine has been adjusted since the brine will circulate without any moisture transfer when its strength and temperature are such that its vapor pressure just equals that of the atmospheric moisture. This process is, of course, possible in a coil cooler alone, and would be possible along the path shown in a water washer if the water temperature and quantity were very delicately balanced (too delicate a balance to be practical commercially). Solid absorbing agents are not applicable since no dehumidification is desired.

The conditioning from C to C′ (Diagram B, Fig. 2) involves both dehumidification and cooling. The process in the brine washer would be along the line C to R which is a combination of dehumidification and heat extraction since the brine is cooled to keep its vapor pressure sufficiently low. The process in the fin-type cooler is along the line R-C′, cooling at constant absolute humidity. The humidistat will govern the operation of the brine concentrator so as to maintain the proper strength of solution, while the thermostat will govern the cooling. This process could be accomplished in the same manner by apparatus using a solid absorbing agent and a cooling coil. In the case of the water washer, the conditioning between these states would involve a very different process. The washer would chill and dehumidify the air to the state S (saturated air at the dewpoint temperature of the final state C′) along the path C-S, which would have to be followed by reheating at constant absolute humidity along S-C′. With a well balanced system employing a cooling coil only, the point S would be shifted to S′ which would reduce both the amount of cooling and amount of reheating required (the reheat may even be sufficiently reduced so that the heat gain of the conditioned space will care for it).

The conditioning from D to D′ (Diagram C, Fig. 2) has the net result of only reducing the humidity since the temperature is the same for both states. The process in the case of absorption dehumidification and a cool-

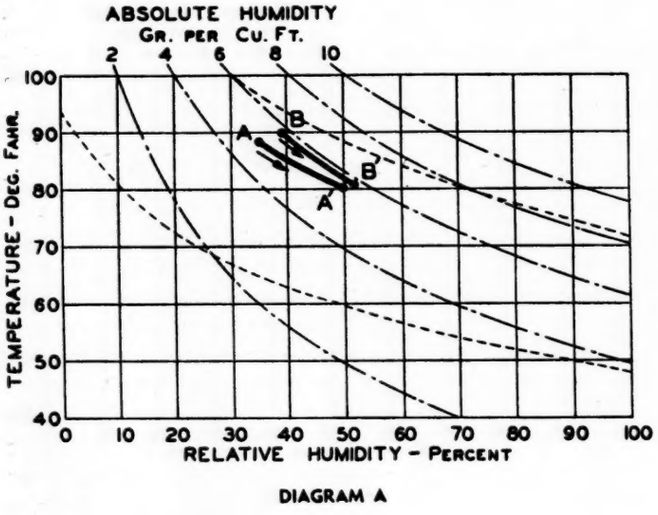
ABSOLUTE HUMIDITY
GR. PER CU. FT.
2 4 6 8 10
TEMPERATURE - DEG. FAHR.
100 90 80 70 60 50 40
A B B′ A′
0 10 20 30 40 50 60 70 80 90 100
RELATIVE HUMIDITY - PERCENT

DIAGRAM A

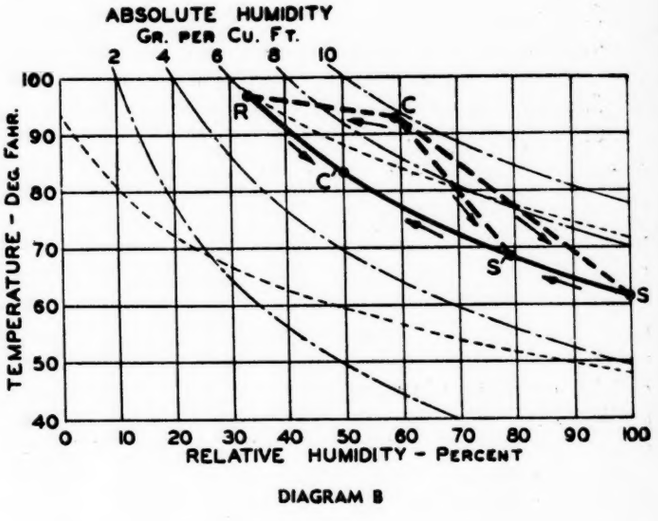
ABSOLUTE HUMIDITY
GR. PER CU. FT.
2 4 6 8 10
TEMPERATURE - DEG. FAHR.
100 90 80 70 60 50 40
R C C′ S′ S
0 10 20 30 40 50 60 70 80 90 100
RELATIVE HUMIDITY - PERCENT

DIAGRAM B

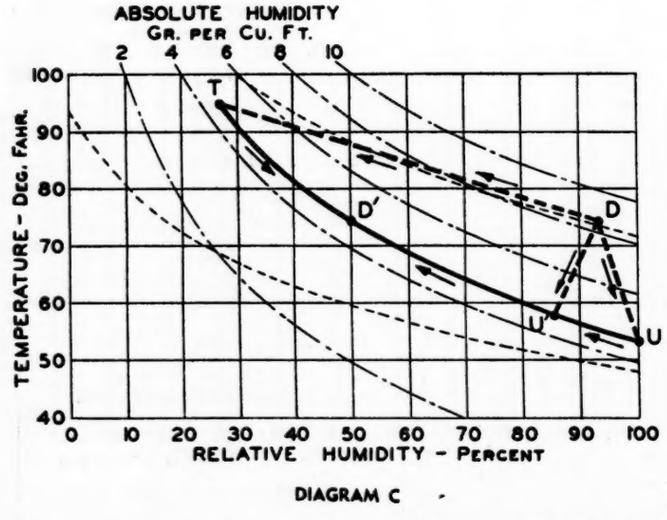
ABSOLUTE HUMIDITY
GR. PER CU. FT.
2 4 6 8 10
TEMPERATURE - DEG. FAHR.
100 90 80 70 60 50 40
T D′ D U′ U
0 10 20 30 40 50 60 70 80 90 100
RELATIVE HUMIDITY - PERCENT

DIAGRAM C

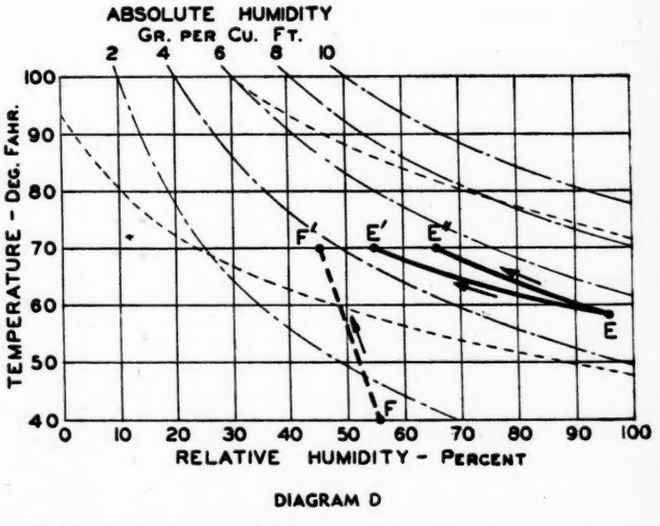
ABSOLUTE HUMIDITY
GR. PER CU. FT.
2 4 6 8 10
TEMPERATURE - DEG. FAHR.
100 90 80 70 60 50 40
F′ E′ E E F
0 10 20 30 40 50 60 70 80 90 100
RELATIVE HUMIDITY - PERCENT

DIAGRAM D

Fig. 2. Temperature and Humidity Relations in Air Conditioning

Solid lines indicate processes, the paths of which can be definitely established. Heavy broken lines indicate processes, the paths of which cannot be definitely established. Arrows indicate directions of processes.

ing coil is by way of T. The process using the water washer is by way of U and using the cooling coil only it is by way of U′ with reheating required in either of the latter cases unless there are very active sources of heat (such as intense electric lighting) within the conditioned space, since there will be no temperature differential and quite probably no sunshine to produce external heating.

The conditioning from E to E′ (E being a cool damp state) (Diagram D, Fig. 2) is readily accomplished through absorption dehumidification as it lies along the line of adiabatic dehumidification. This could, of course, be approximated by heating at constant absolute humidity, E to E′. Since no change of humidity is important, the water washer would not be applicable. However, the adiabatic dehumidification, which is accompanied by a rise in the dry bulb temperature, will be advantageous in many applications where the heating plant is not operated during the summer months.

The conditioning from F to F′ (Diagram D, Fig. 2) which involves heating and dehumidification is representative of winter conditioning. The humidification can be accomplished either by the use of the brine washer or with the water washer. In this case the fin-type coil in the brine apparatus would serve as a heater, this change being seasonal. Systems using solid absorbing agents or cooling (heating) coils only cannot accomplish the required humidification.

Thus, it will be seen that a system of air conditioning using a hygroscopic aqueous solution (such as calcium chloride brine solution) combines the most advantageous features of all of the methods at present in common use. The cost of the equipment should be about the same as for a water washed installation and may be considerably less since the cooling water temperature should be above 60° in order to avoid sweating on the fin-type coil. Cooling water at temperatures up to 70° can be employed successfully if the fin-type coil is of ample capacity. An installation in a Chicago residence which employs silica gel for dehumidification and water from the city mains for cooling (water temperature up to 70°, or even 72°) has been giving very satisfactory results.

The use of cooling water at these relatively high temperatures will obviate the necessity of refrigeration in many installations. In those cases where mechanical refrigeration is required, both the first cost and the operating cost will be reduced because of the higher temperature and pressure in the "low side." This will be particularly true in the case of the steam jet vacuum equipment. Even in cases where ice is used for refrigeration, the first cost will be somewhat less because the high temperature differential between the ice and the cooling water will permit simplified ice bunker design.

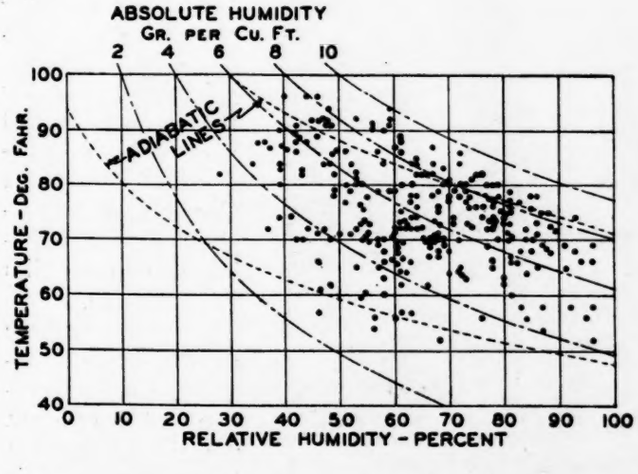

Fig. 3. Weather data for Chicago, June 1 to August 31, 1931 (from monthly summaries, U. S. Weather Bureau)

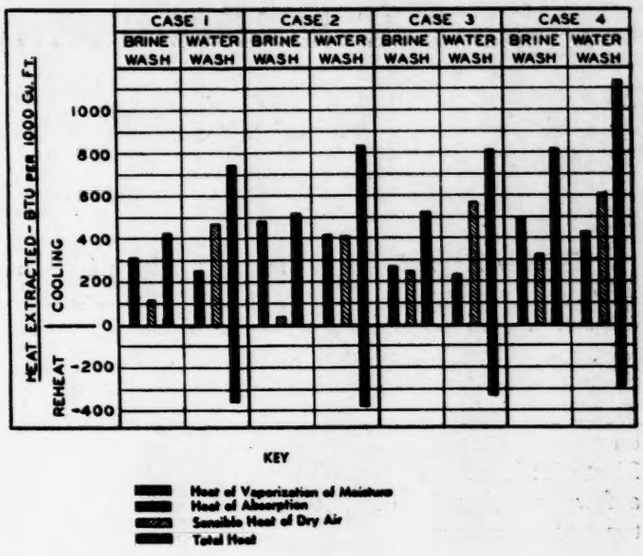

Fig. 4.

Comparison of Heat Quantities Involved in Air Conditioning

	Case 1	Case 2	Case 3	Case 4
Initial Temp.	80°	72°	90°	95°
Initial R.H.	60%	80%	47%	50%
Temp. Leaving Apparatus.	74°	70°	76°	77°
R.H. Leaving Apparatus..	52%	50%	55.8%	57.5%
Room Temp.	77°	72°	81°	83°
Room R.H.	50%	50%	50%	50%

Fig. 3 gives a measure of the relative importance of the different processes cited above in the city of Chicago between June 1 and August 31, 1931. Each point on the chart represents a published observation, of which there are three for each day (7 a.m., noon, and 7 p.m.). The distribution of the points on the chart would change slightly from year to year for any one locality and might be markedly different for another locality.

A comparison between the heat quantity involved in the use of the brine washer-fin coil cooler equipment and the water washer (usual type) with a reheater, when conditioning between certain initial and final states, is shown in Fig. 4. In the case of the conditions recommended for design for Chicago (90° dry bulb, 73° wet bulb, approximately 47% relative humidity) the reduction of the required refrigeration capacity is 35% as shown in case 3, Fig. 4.

In the cases shown the total quantity of heat involved is always less with brine washing than with water washing. This will be true in any case involving dehumidification unless the difference between the dry bulb temperature of the condition at the outlets of the apparatus and the condition in the room is approximately 20°.

Air Conditioning and Ventilating a 31-Story Office Building

By E. C. PARKER

THE new Home Office of the Metropolitan Life Insurance Company, New York, is the first completely air conditioned office building built in the east, and this, coupled with the size of the project, has attracted the attention of engineers over the whole country as well as those in a number of other countries. Located on Fourth Avenue, at East 24th Street, the building is 31 stories high, has four sub-basements and, excluding a few exceptional spaces, is air conditioned from the top to the bottom.

Air Conditioning

Fig. 3 shows a diagrammatic section of the air conditioning system. For the general office building the fresh air intakes are located on the 15th floor. The air is passed through the dehumidifiers and then split up into four systems—north up-feed, north down-feed, south up-feed, and south down-feed. The dehumidifiers for supplying air to the cafeteria areas in the second and third basements and the ventilating fans for the basement are supplied air from the fresh intake through screened grille openings on the first and second floor. Based on 72° temperature and 45% relative humidity, the conditioning system handles 248,000 c.f.m. fresh air and 293,775 c.f.m. recirculated air.

Four refrigerating machines, each having a rated capacity of 325 tons, are located in the fourth sub-basement. The cafeteria conditioning system receives its refrigerated water through interchangers located in the fourth basement, so that by a manipulation of valves, this system may be shut down when not required without interference with other systems. After passing through or around the interchangers, this water is carried to the four dehumidifiers on the 15th floor. The return water, plus the moisture condensed from the entering air, is then carried to the surge tank on the 13th floor and then back to the refrigerating compressors.

It was apparent at the start of the construction that due to the different piping, vent ducts, air conditioning ducts, electric conduits, pneumatic tubes, etc., that must be run in the hung ceilings, great care and cooperation was necessary among the various contractors in running their work, so as to maintain maximum ceiling heights. In order to expedite this work composite drawings were made.

Piping and ducts had to be rerouted and sizes in many instances were changed. The final drawings showed all the work for the various trades with the absolute elevations at which they were to run. This having been accomplished, clearance lines denoting the lowest point of any work was shown in each bay, which enabled the architects to have their ceiling plans revised in ample time.

Two recirculating or booster units are located on each floor. Through this mixing chamber, with air-operated dampers, the recirculated air after passing through sound absorbers is mixed with the conditioned air and passed through the fan to the floor sections. The surplus exhaust is carried back to the 15th floor and discharged to the atmosphere. Some idea of the air distribution may be had from Fig. 1, which shows the ceiling steps, determined by the layout of ducts and outlets, with the outlets for distribution.

Fig. 6 gives some idea as to the complexity of ducts and piping of the ventilating and conditioning systems.

Ventilation

The general ventilation system, Fig. 4, takes in supply and exhaust for toilets, cleaners' closets, kitchen, cafeteria serving counters, back counter spaces, dishwashing rooms, locker rooms, storerooms, and the entire fourth basement, which is devoted entirely to storerooms and mechanical equipment. There is a separate exhaust system for the photo bureau, 8 photostats, 2 rectigraphs, 2 driers, and Cooper-Hewitt machines. The ventilating system supplies 126,700 c.f.m.

Inasmuch as these machines are automatic in their operation and in constant use daily, an even temperature for their cold water supply

Fig. 1. Steps in ceiling accommodate the conditioned air outlets

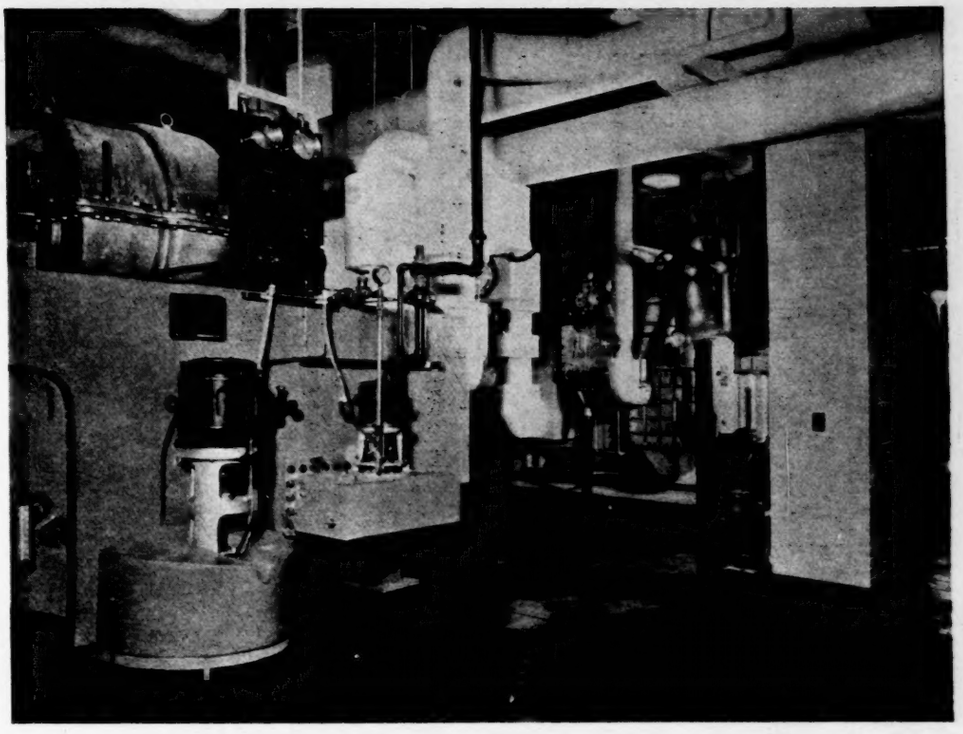

Fig. 2. A view of the air conditioning machinery room showing the compressors.

was necessary. A separate cold water system was designed, using an interchanger supplied by refrigerated water. A hot water line and a chilled drinking water line for emergency use was connected with bypasses to a thermostatic mixing valve so that an even temperature of 70°, plus or minus 2°, may be maintained in all seasons.

The photo bureau installation was an after thought when the building was 60% completed. Air conditioning ducts had been installed for the area, and ceilings had been constructed.

After several plans were submitted, it was agreed that due to the extreme amount of heat given off by the photostat and rectigraph machines, exhaust ventilation only would be installed, the supply being obtained through opened windows. Both space and expense were governing factors in arriving at this decision.

Hoods were designed to set over the heating units of each machine, as low as practicable. The exhaust duct trunk line, run behind the machines and close to the adjoining wall, and the previously installed air conditioning ducts, blanked off the ceiling behind the wall.

The research laboratories of the National Board of Fire Underwriters have pointed out that the highest temperature in a room is not at the ceiling but between 6 in. and 12 in. below the ceiling. In designing the hoods, this was kept in mind. By keeping the ceiling under the exhaust trunk line and between each of the hoods 6 in. higher than the lower edge of the hood, the hood does as effective a job as though it were twice the size. Too, this additional 6 in. improves the headroom materially in this section.

Separate ventilating systems are provided also for dishwashing rooms and cafeteria service-counter; elevator machine rooms; toilets; gymnasium; kitchen; fourth basement, and refrigerating machine room. Toilets are equipped with exhaust only, supply being by seepage through the corridors. In each toilet room the doors have been undercut, and also have a wall duct with a bottom register on the corridor side and a top register on the toilet side.

In all these areas air conditioning is not practical, due to odors or excessive heat, making 100% fresh air supply necessary.

The building contains the largest kitchen in the country, meals being prepared for 13,000 persons daily. A new method of supply around kitchen hoods was adopted. The exhaust duct with its numerous outlets runs down the center of the hood. Supply ducts are housed alongside this exhaust duct with regularly spaced outlets, but the grilles are set at about a 45° angle, as shown in Fig. 5, so that the entering air will pass over the heads of those workers under the hood or at the cooks' tables nearby. This has the effect of confining the cooking odors to the hoods and protects the workers from any direct blast of air. In the hottest days of June the temperature was maintained at a comfortable point, considering outside conditions, and the cooking odors were not noticeable over 30 ft. away from the hoods.

The entire first basement, exclusive of space required for mechanical equipment and stairways, is devoted to the kitchen. Steam and water demand for this area is very high and presented a difficult piping problem. Some idea may be had as to the network of pipes and ducts in this ceiling by the fact that a height of 6 ft. 9 in. was used for ducts and pipes. The net area of the kitchen is 24,620 sq. ft.

Laboratories take up the entire 26th floor, where electric, gas, steam, hot and cold water connections as well as compressed air had to be furnished. The necessary drainage, return piping, separate fume hood exhaust, etc., made it necessary to install a pipe trench in the floor.

Water and Steam Service

Water is carried from meters on the first basement level to the suction tanks and condensers in the fourth basement. Hot water and chilled drinking water are supplied to each floor. The average daily water consumption in winter and spring for all services is 24,300 cu. ft., or 182,250 gal., while the maximum supplied in one day was 132,000 cu. ft., or 990,000 gal. on an ex-

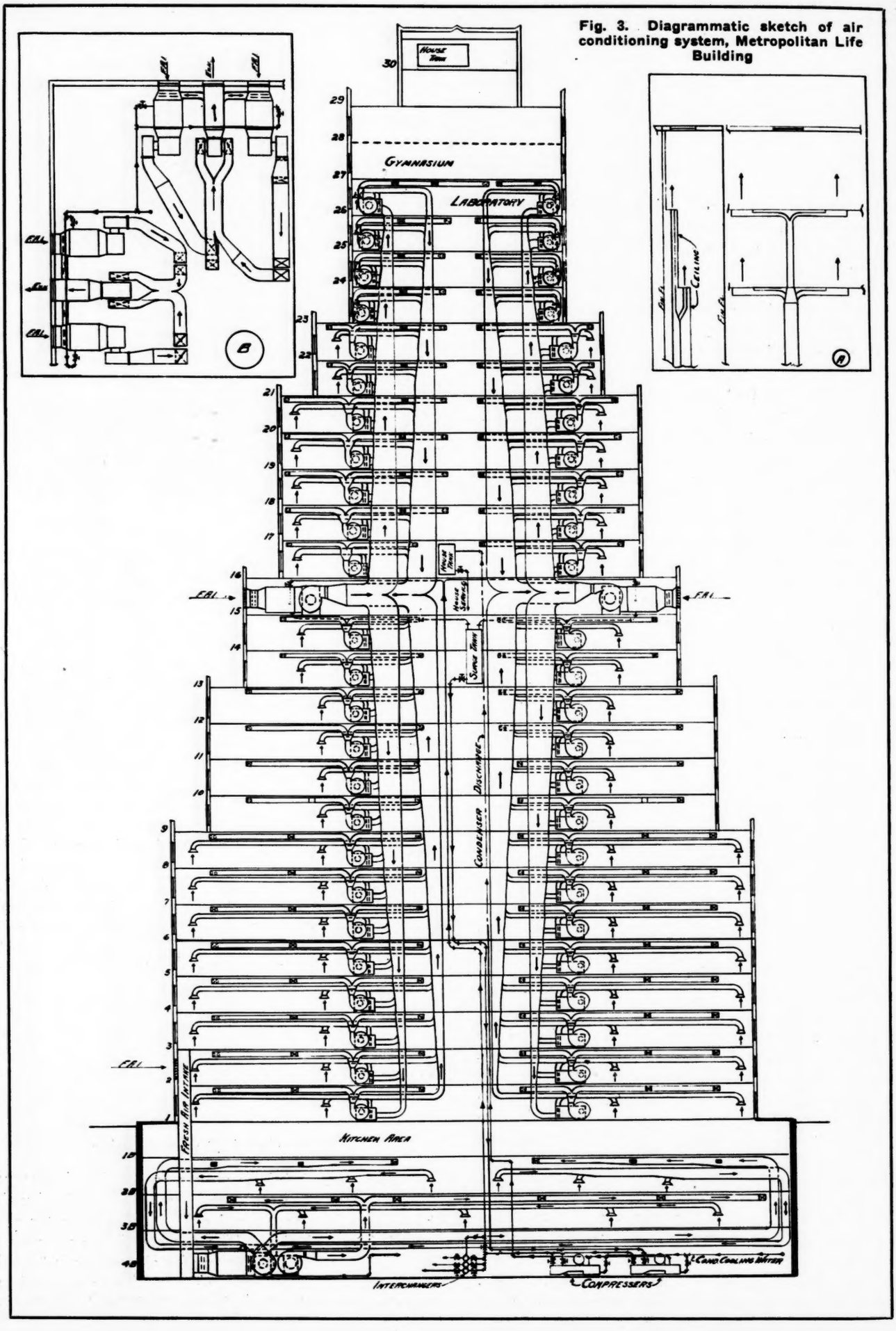

Fig. 3. Diagrammatic sketch of air conditioning system, Metropolitan Life Building

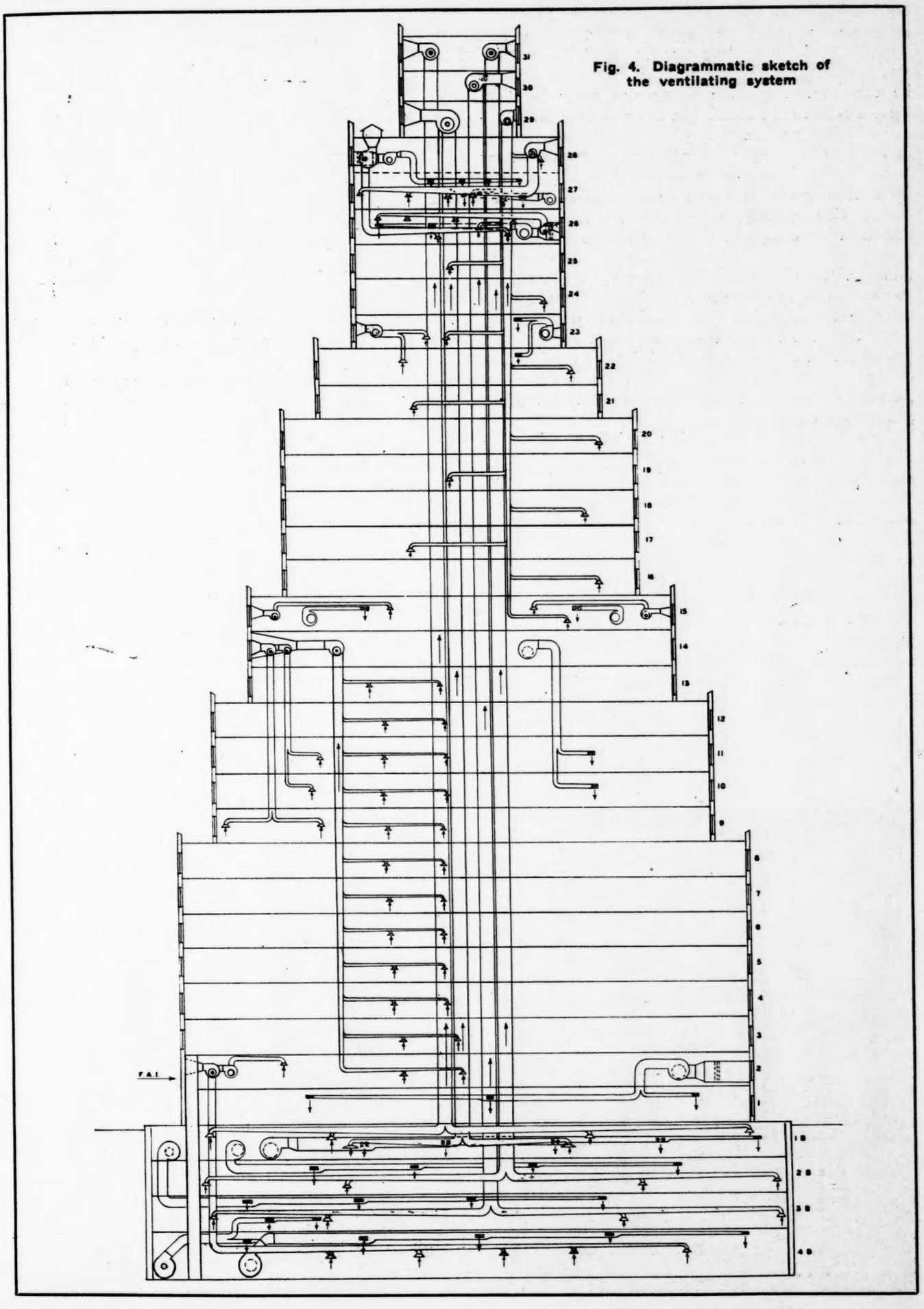

Fig. 4. Diagrammatic sketch of the ventilating system

ceptionally hot and humid day when the air conditioning compressors were running at capacity. Most of this water is used for condenser cooling, and if the water was used only for this purpose the cost of water would be excessive. Since the Company's other building, located across the street, has a daily average consumption of 32,000 cu. ft. of water, and the summer demand in the new building is estimated at 40,000 cu. ft. for house service, it was estimated that the daily average for condenser cooling would be approximately 90,000 cu. ft. Consequently, a back-pressure valve was installed in the condenser discharge line to insure sufficient pressure to pass through the filters in the old building. Taps from this line to the high ball cocks on the suction tanks of the new building will use most of this water, allowing but 18,000 cu. ft. to be passed to the sewer direct. In other words, with this arrangement 18,000 cu. ft. daily are required for air conditioning over and above the normal demands for house services, giving a direct cost chargeable to air conditioning of $18 daily for water.

Steam is supplied by the New York Steam Corporation at 140-lb. gauge pressure. After passing through the utility's meters, it is reduced to 90 lb. and then to 50 lb. for distribution in the building. From the 50-lb. header, lines are carried to the 15th floor header room and there pass into up and downfeed systems for both air conditioning and heating services. All returns and drips are carried to the fourth basement and, after passing through economizers which heat the intermediate and a portion of the low level hot water systems, the condensate is pumped across the street to the old building and used for flushing toilets.

During the heating season a maximum of 276,000 lb. of steam were used. The average for the season of all steam services, including kitchen and laboratories, was about 121,500 lb. per day.

A few figures to show the relation of the mechanical equipment to the completed structure may be of interest. The total dead weight of the building itself is 139,000 tons.

The weight of mechanical equipment in tons is:

Air conditioning	691.6
Ventilation	875.0
Heating and steam piping	380.0
Plumbing	576.1
Temperature control	23.9
Refrigeration (exclusive of air conditioning)	213.0
Pneumatic tubes	102.0
Elevator and escalator equipment	1560.0
Electrical (exclusive of motors and starters)	1347.0
Kitchen and cafeteria equipment	120.0
Treyveyors and conveyors	48.0
Photostats and rectigraphs	25.0
	5961.6 tons

This weight comparison shows that the mechanical equipment makes up 4.3% of the total dead weight of the building.

There are over 6000 employees working in air conditioned sections of the building, 564,465 sq. ft. of floor area, or 6,230,980 cu. ft. of space, air conditioned.

The following comparison shows the area used exclusively for the mechanical installation, but does not include the ceiling space necessary. The total area of the building is 1,171,284 sq. ft.

Mechanical equipment areas	176,530 sq. ft. or 15.1%
Walls, partitions, and furred spaces	145,103 sq. ft. or 12.4%
Service areas, stairs, and corridors	171,561 sq. ft. or 14.6%
Net area	678,190 sq. ft. or 57.9%

Expressed in cubic feet the space is divided as follows:

Total cube of the building	14,911,713 cu. ft.
Net area (hung ceilings deducted)	6,936,802 cu. ft. or 46.5%
Stairs and corridors	1,882,610 cu. ft. or 12.6%
Walls, partitions and furred spaces	1,774,371 cu. ft. or 11.9%
Mechanical equipment	4,317,930 cu. ft. or 28.9%

Electric Service and Fire Protection

Electric service for both power and light is furnished through a battery of transformers located under the sidewalk on the first basement level and also through cables carrying 13,200 volts across the first basement ceiling, then upto the 15th floor to other transformers for general distribution. The total connected load is 6186.6 kw., of which the power load is 5734.44 kw.

Fig. 5. Supply outlets on side of range hood in kitchen are placed at an angle so that entering air does not strike the kettles or workers.

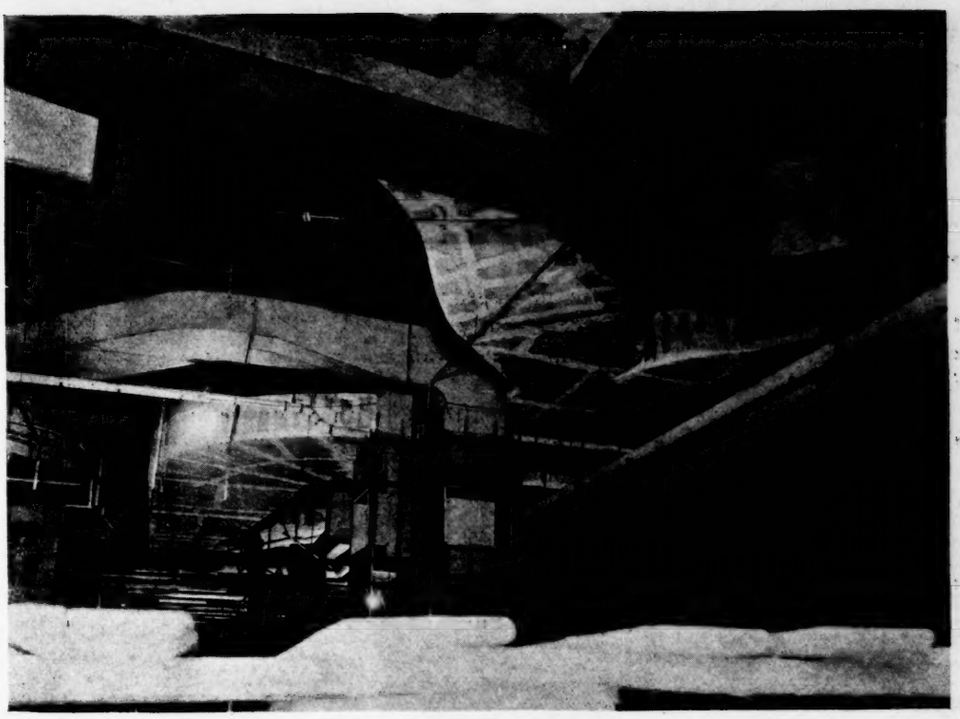

Fig. 6. Section of second basement during construction

The major portion of this electric load is used for heating, ventilating, and air conditioning, the air conditioning system using 2179.61 hp. and the ventilating system 599.72 hp.

Pneumatic tubes expedite inter - departmental communications as do the correspondence conveyors which link six floors whose departments are closely allied.

Fire protection has been given a prominent place in this installation, since, due to the nature of the business, the records and files could not be replaced by fire insurance. The large number of employees housed in this structure made it necessary to reduce the danger of panic to a minimum. With this in mind, dampers were placed in all ventilation and air conditioning ducts, with readily accessible break glass damper control stations, so as effectively to cut off any area in which fire might occur, and so that smoke or odors might not be transmitted to other areas through them. These dampers also serve to confine the fire so that CO_2 forced into the duct from portable tanks will quickly smother the blaze. As a further preventative measure, all ducts are thoroughly cleaned semi-annually and oftener if necessary.

Operation and Maintenance

The entire heating system is thermostatically controlled and a temperature of 72° maintained during the winter. Complaints arose that chilling drafts were causing discomfort. The workers had been accustomed to offices where the heating system was not thermostatically controlled, with comparatively little air movement, and were used to a temperature of 80°. The air movement here, and the constant temperature, together with the fact that orders were issued forbidding the opening of windows, was a bit incomprehensible to these employees. A campaign of education was decided on by the operating engineers to acquaint the occupants with the system, its merits, and what it was expected to accomplish. The immediate result was a diminishing number of complaints.

Leaking diaphragm valves on the radiators were a source of annoyance. Various types of discs were tried before one was found satisfactory. This of course involved a great many tests under actual working conditions. Every boiler plant has a problem in its treatment of feed water. Two plants a mile apart may have very dissimilar conditions, and as a result a different treatment of this water. Whatever the treatment, it has a pronounced affect on the discs of diaphragm valves. Being a composition, the chemical content of the entering steam will have a varied effect. It is the writer's belief that these discs should be tested under actual working conditions of the particular job before their installation.

Location of the job with reference to its surrounding plants presents another variable condition in the acid content of the entrained moisture in the entering air. In this particular installation it was found, after 80 days' operation, that orifices of spray nozzles of both the air washers of the ventilation system and the dehumidifiers of the air conditioning system were attacked, and the resulting corrosion had increased the diameter, irregularly, by a third. The acid had also attacked the eliminator plates, through cracks in the protecting coat, which seemingly the utmost caution cannot prevent in erection, to an alarming degree. Water treatment for both systems was evidently needed and after a few chemical tests this treatment was installed. Eliminator plates were recoated and after 80 days' operation another check was made. The spray nozzles were found to be in perfect condition and no further corrosion manifest on either the housing of the washers or the eliminator plates.

Since there are so many isolated power and heating plants, and so much automotive traffic in the immediate vicinity the writer feels that a great deal of care should be exercised in locating the fresh air intakes for any ventilating or air conditioning system. In urban communities where much soot and smoke is present the air washers do not remove enough of this soot properly to protect the walls and ceilings. This is particularly noticeable around the supply grilles and registers, and in the writer's opinion, dry filters should be given greater consideration on fresh air intakes.

Swarthmore Builds New Concrete Pipe Tunnel

Details of construction of the underground steam distribution system for Swarthmore College, Pennsylvania

By L. S. TARLETON†

THE most modern practice in underground steam transmission is exemplified by the recently completed concrete pipe tunnel on the campus of Swarthmore College, Swarthmore, Pa.

About five years ago, the college was confronted with the problem of renewing its underground steam mains connecting the power plant with the principal center of distribution, located in Parrish Hall, approximately 1100 ft. from the boiler house. The original lines had been laid in tile conduit in 1911, and leaks and shutdowns for repairs were recurring with increasing frequency.

In deciding between laying the new lines in underground tile and the somewhat more costly pipe tunnel proposition, a consideration of the difficulties and lost time experienced in making repairs to the old installation convinced those responsible for its operation that the tunnel would be the more economical in the end.

There was also another consideration. The underground high-tension feeders from the college's private plant were in need of replacement, and since these cables paralleled the steam lines, it was felt that the inclusion of the new feeders in the tunnel would be a desirable feature, since electrical maintenance would likewise be facilitated.

When prices for the proposition were submitted, the college authorities felt that the cost of the entire project was too much to be taken in one "bite," and it was decided to construct a section 330 ft. in length, or from the power plant up to a take-off for the library. At the same time, this would materially overcome many of the previous difficulties, as the greater part of the trouble had been with the lower portions of the lines.

In the early part of this year it was felt that the time was ripe to complete the tunnel. Construction costs were at their lowest, and the college was assured from all quarters that it was exceedingly doubtful whether they would again be able to build as cheaply. New estimates were obtained, and the contracts concluded, the terms of which were more than sufficient to justify the decision to proceed with completion.

At the power plant, electrical energy for the college is generated by non-condensing engines operating at 125-lb. pressure and about 5-lb. ga. back pressure. The exhaust from the engines and auxiliaries is piped to a low-pressure distribution main having, of course, a connection in the plant for the purpose of heating feed water. There is likewise a make-up connection at the plant, using a reducing valve, so that live steam may be admitted in the event of a deficiency in the exhaust.

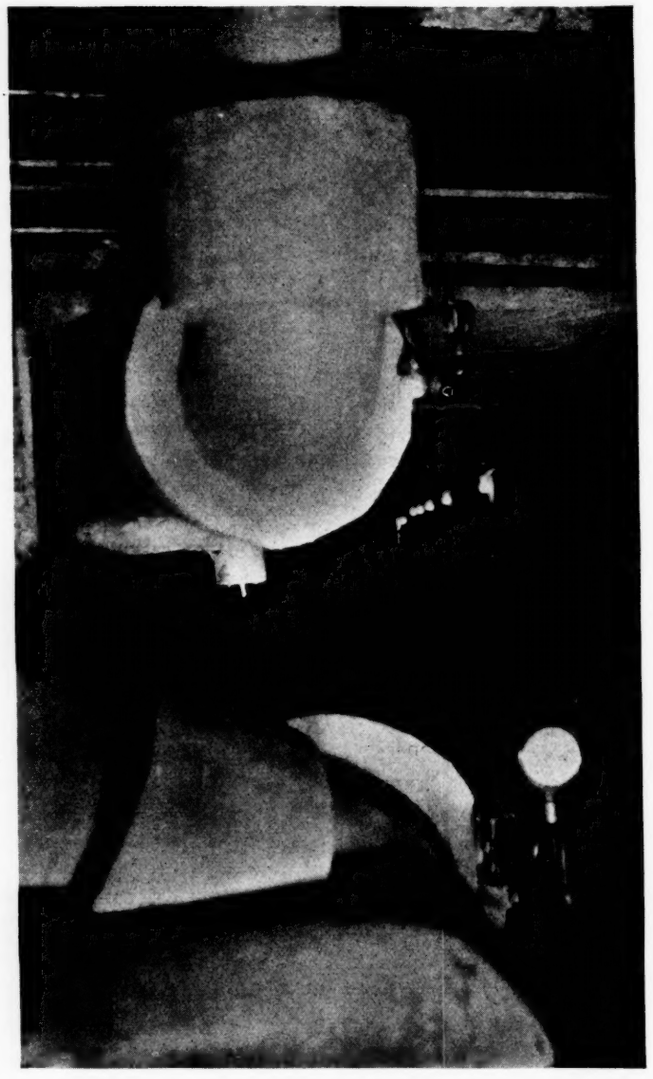

Fig. 1. Looking toward Parrish Hall entrance to the tunnel. The horizontal pipes at the top of the illustration are conduits carrying the high-tension feeders. The duct at the right-hand side has been installed for the double purpose of ventilating the tunnel and supplying heat to certain portions of the building.

Three main pipe lines extended underground to the distributing point in Parrish Hall; namely, a 5-in. high-pressure steam line, a 9-in. low pressure steam line, and a 3½-in. return line. The returns are discharged into a vented surge tank at the power plant, from which they are pumped to the feed heater.

At the time that the tunnel was designed there were three take-offs from the mains between the power plant and Parrish Hall. These were steam connections to a group of fraternity houses, to the library, and to a building designated as Wharton Hall.

When the plant was first built, a short section of

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tunnel was run for about 50 ft. from the plant under the plant's railroad siding and under the main tracks of the Pennsylvania Railroad's tracks. Although this tunnel was built with low headroom, about 5 ft., it was deemed advisable not to disturb it, owing to the expense involved in working under the railroad's right-of-way. This section was, however, effectively treated and waterproofed, which it had not been previously.

The new tunnel was designed for a full standing head room of 6½ ft. and 6 ft. in width. In the design of piping and supports, considerable thought was given to future maintenance, and it is possible to remove any line in its entirety without disturbing the supports of any other line.

Continuous inserts were placed on close centers (6 ft. to 8 ft.) on both sides and in the ceiling of the tunnel. This not only made it convenient for the installation of the lines required at this time, but simplifies greatly the addition of future lines. A special manhole was designed in such a way that entire lengths of pipe may be brought in. This eliminates the inconvenience of carrying pipe lengths either through the building or through the power plant.

A study of the present and future steam needs of the college indicated the necessity for increasing the pipe sizes. Accordingly, the new lines comprise a 6-in. high-pressure steam main, a 12-in low-pressure steam main, and a 5-in. return line. Steel was used for the high and low-pressure mains, while wrought iron was employed for the return. Line weld construction is used throughout, with Van Stone flanges at valves and expansion joints. Take-offs are made in general with welded nozzles.

The original connection to the library was designed for high pressure, with a reducing valve at the building, but in the design of the new mains, the addition of a cross-over connection was made to the low-pressure main, so as to take advantage of excess exhaust in mild weather.

In the case of two of the branch take-offs, it was necessary to cross the tunnel with the branches. At these locations, the ceiling of the tunnel was raised to permit the branches to cross without disturbing the headroom. Where any take-off occurs, a manhole has been placed above, so that admission of material for repairs or replacement can be expedited.

Expansion joints are of the slip joint, internally and externally guided type, and their location was determined by the study of several variables. Obviously, there are advantages to placing joints at the take-offs, since by locating the take-off on the stationary side of the joint, no provision need be made to accommodate movement of the branch. Again there are advantages in locating the joints at points where the incline of the mains changes grade, since flexural stresses due to movements of these points can be avoided. The actual locations selected were determined from a balance of these two considerations, as well as from the knowledge of the actual traverse capacity of the joints.

Before starting construction this year, however, it was necessary to recognize certain changes which had taken place since the conception of the original tunnel. Among these was the erection of Clothier Hall at a point about 800 ft. from the power plant.

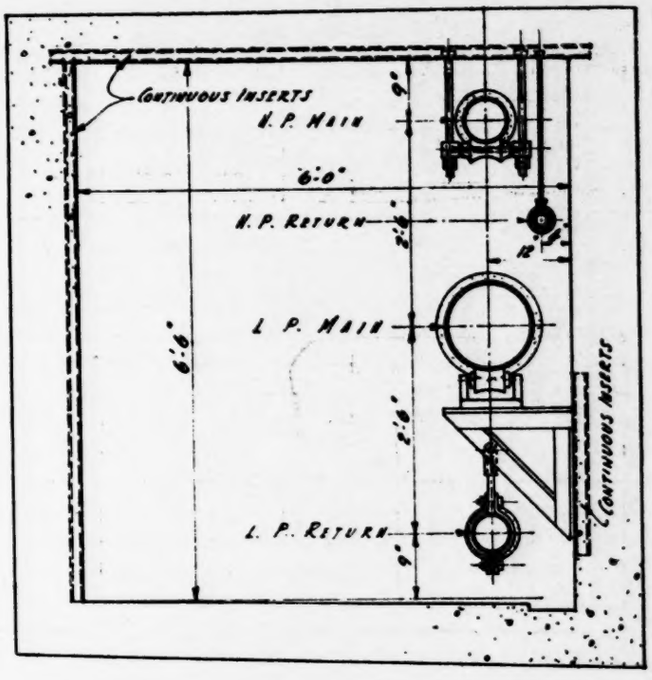


Fig. 2. Typical section through tunnel showing arrangement of piping, hangers, and supports

When this building was designed in 1929, the engineers gave careful thought to the relationship of a manhole required for the steam take-off and the location of the proposed tunnel. In fact, at one time the possibility of constructing a short section of the tunnel itself, and utilizing it as a manhole, received serious consideration. This scheme was abandoned, however, since the location of expansion swings and anchors in the old lines was quite different from the contemplated location of joints and anchors in the new tunnel. This meant that it was almost impossible to devise an arrangement of piping for the Clothier Hall take-off which would remain undisturbed at the time that the new tunnel was built. Hence, it was decided to build a separate manhole for this take-off with one side adjacent to the future wall of the tunnel. Another side of the same manhole was made adjacent to a manhole which housed the branch connections to Wharton Hall.

As a result of the study of this condition, it was decided to remove these two partition walls of the Clothier Hall manhole, and leave a corresponding recess in the side of the tunnel. This meant that the Wharton Hall manhole and the Clothier Hall manhole became one large recess on the side of the tunnel.

The branch connections were then redesigned so that one branch for the two buildings is taken off the mains, this branch being divided in the recess. Here again the cross connection between high and low-pressure mains is utilized, so that in severe weather high-pressure steam is reduced to pressure suitable for heating purposes, while in milder weather exhaust steam can be utilized.

In so designing these cross connections, it was recognized by the engineers that some danger existed if the valves controlling these connections should be manipulated by a careless operator, as it might be possible to place 125-lb. pressure on the low-pressure system. As

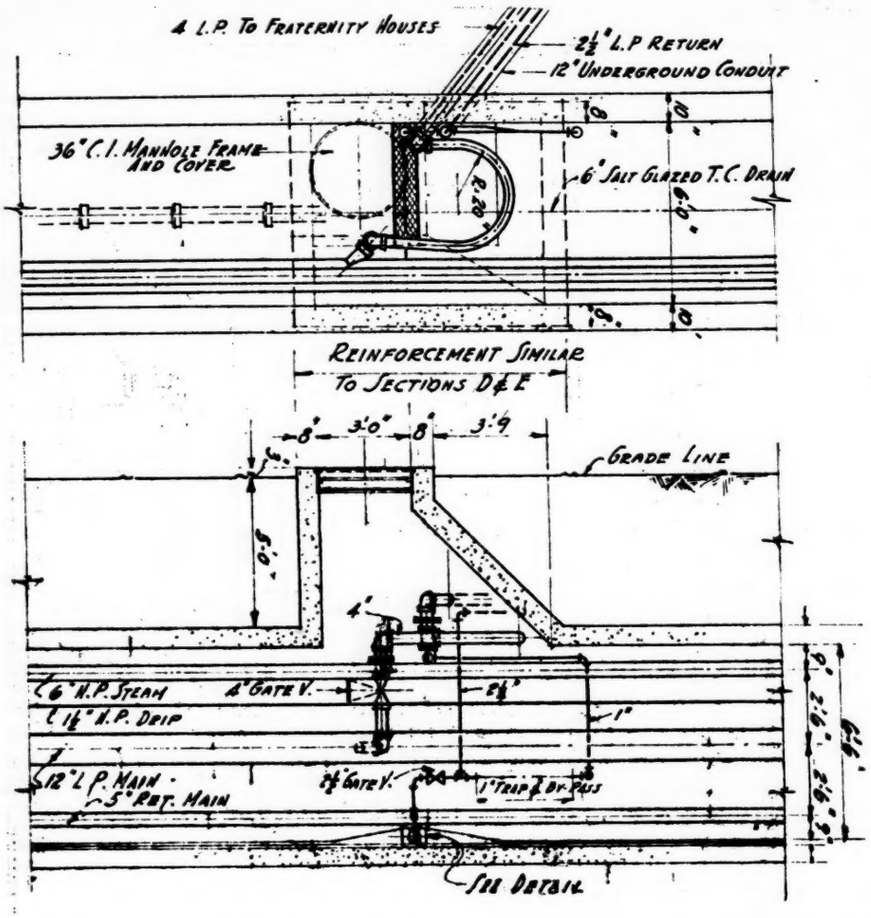


Fig. 3. Special manhole designed to permit the introduction of tools and full lengths of pipe. This simplifies maintenance by obviating the necessity of maneuvering such material through the power plant or the windings of Parrish Hall basement.

a safeguard, a high grade check valve is placed in each cross connection, but the operating force has been strongly cautioned against the advisability of any but the most experienced operators using these valves. The college engineer will provide for the locking of these valves, so that only an authorized person can operate them.

Certain experiences in operating the first constructed section of tunnel proved useful in constructing the second portion. The operators found that in repacking and servicing the expansion joints, the fact that they could not get in behind them proved a handicap. Consequently, the latest portion of the tunnel contains recesses 18-in. deep behind each expansion joint, so that access is now possible on both sides.

The tunnel, as completely constructed, rises from the plant to Parrish Hall with three grades. Starting from the section of tunnel under the railroad, it inclines at a 3¼% slope for 375 ft., at which point the grade increases to 10%. This continues for 425 ft., after which the tunnel returns to a 5% grade, at which it enters the basement of Parrish Hall. The tunnel in general follows the contour of the grade, but the depth of the top of the tunnel below grade varies from 3 ft. to 8 ft.

During the testing of the completed lines, the writer observed a phenomenon which was new in his experience, but which may have been observed by some of the readers. Steam was being placed on the 12-in. line to check the movement of expansion joints, and the rigidity and security of all anchors. Needless to say, the steam was being admitted very slowly, so slowly that it took about 3 hr. before the entire line was hot. As the steam advanced, it was noticed that the line "humped" itself off the rollers for a height of as much as 5 in., the entire length of the "hump" being about 50 ft. Investigation showed that the top of the pipe heated for some distance ahead of the bottom, and quite naturally the top expanded before the bottom, thus causing the pipe to arch. Undoubtedly, the returning condensation on the bottom kept the bottom cool for some time. As the bottom became hot, the pipe would return to its place on the rollers and assume its original position. Some conjecture was aroused as to what takes place in a similar line when encased in underground insulating conduit. It would seem as though severe stresses in the tile and possibly breakage would be a possibility.

An examination of the relative costs involved is interesting as an indicator as to what has taken place within the last few years. Briefly summarized, a comparison of the 1928 and 1932 sections looks something like this:

	1928	1932
Cost per running foot of concrete work.....	100%	45%
Cost per running foot of pipe work.....	100%	70%
Cost per running foot of completed tunnel..	100%	55%

These comparative figures do not include costs arising from unusual conditions, such as rock excavation, tree shoring, etc., as these items were kept separately. They do show, however, that it actually cost less to build 705 ft. of the 1932 tunnel, without piping, than it did to build 530 ft. of the equivalent 1928 tunnel, under identical specifications.

A Review of Cast-Iron Direct Radiators

RADIATORS can be classified in several ways. One of the earliest methods of classification was by material, in order to distinguish between the common cast-iron direct radiator and the then new convection-type heaters, grouped together as non-ferrous. This classification no longer holds good, principally because cast iron is finding wide application in convection heaters. Another general classification was between the convection-type radiator on one hand and the direct radiator, which gave off the greater part of its heat, in the form of radiant energy, on the other hand. This classification, too, is more or less obsolete, due to the fact that a number of units now on the market, or in the process of design, are almost equally radiant heaters and convection heaters.

A third classification, adopted for the purpose of this series of articles, is simple, and divides the units into direct cast-iron radiators, cabinet-type units and concealed units—all classified regardless of whether they give off their heat as radiant or convective heat, and regardless of the material of which they are made. This article, the first of a series of three, is concerned only with the cast-iron direct-type radiators.

It is now about eight years since the present popular tubular-type radiator was introduced. Five years later, practically all the manufacturers had changed their patterns and turned to the production of this slender and far more attractive unit.

In order better to be able to compare the various makes of radiators a table was prepared showing dimensional and capacity data of standard tubular radiators. It contains so much information in a small space that it is reproduced here as Table 1.

This table gives the capacity in square feet per section, width of sections, length of section, and number of tubes of the cast-iron tubular radiators made by 17 manufacturers, believed to represent at least 95% of the output in this country.

Although sizes have not been standardized, there is one dimension common to practically all units — the length of section, which is 2½ in. regardless of the number of tubes or height. The only case where this dimension does not apply is in the so-called junior models made by three manufacturers, and tabulated in Table 2.

Referring to Table 1, the letters appearing in this horizontal column opposite width of section in Table 1 are symbols for the names of the various manufacturers, the key to these symbols being listed separately.

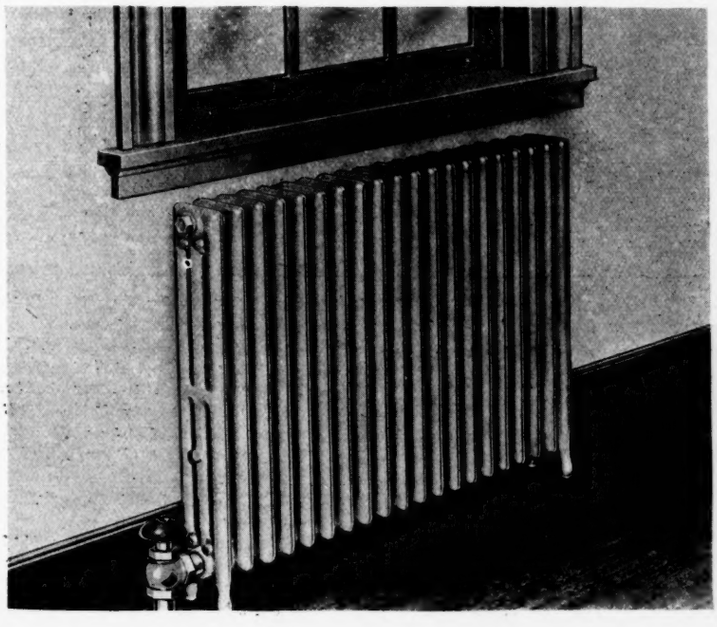
There are a large number of footnotes, and these require some explanation. The table assumes that every manufacturer can supply all radiators, and that all radiators are of the capacity given in the table. Since this is obviously not the case, the footnotes show what manufacturers can or can not supply, and also what the rated capacity is if it differs from the figures given in the table.

For example, the 3-tube, 38-in. radiator is listed as having a capacity of 3 sq. ft. per section. Footnote 1 explains that RR rates this at 3 1/3 sq. ft. per section, and also that N, R, US, and CB can not supply. In other words, this size is available from all manufacturers except the four named, and of the 13 remaining makers all except Republic rate it at 3 sq. ft. per section.

Similarly, we find that the 7-tube, 38-in. is rated at 7½ sq. ft. Footnote 23 shows that this is available only from P (Pierce, Butler and Pierce) and from R (Republic). The figures in parenthesis after the P indicates that Pierce rates this model at 7½, while the figure after the RR indicates that Republic rates it at 7 sq. ft. per section.

Fig. 1. (Below) Standard size tubular radiator. Fig. 2. (Right) Comparison of sizes of senior (standard) and junior tubular radiators.

American Radiator Co.



Weil-McLain Co.

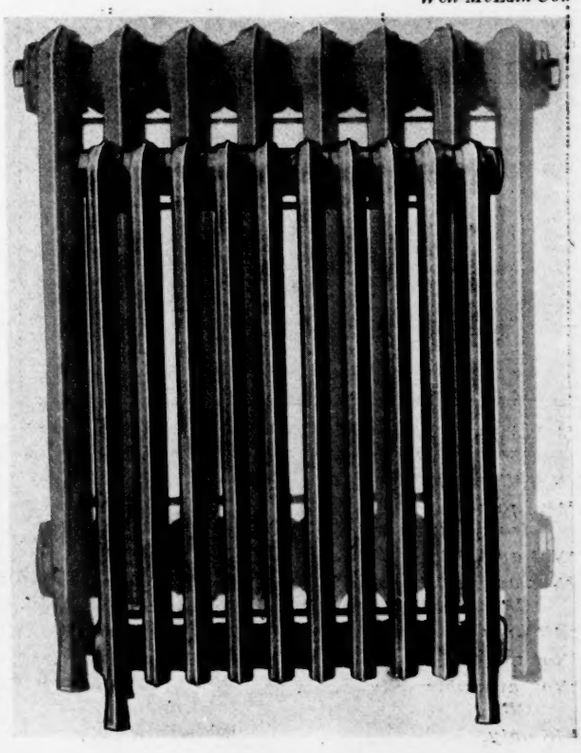


TABLE 1—DIMENSIONAL AND CAPACITY DATA—TUBULAR RADIATORS

NUMBER OF TUBES	3-TUBE	4-TUBE	5-TUBE	6-TUBE	7-TUBE
LENGTH PER SECTION, IN. (Add ½" for Inlet, ½" for Outlet bushing to total computed length of radiator)	2½	2½	2½	2½	2½
WIDTH OF SECTION, IN. (Width of section same as width at legs for all cases except: A-Leg width = Section width plus 1/8" F-Leg width = Section width plus 1/8" for 3 and 4 tube. Other F sizes leg and section width the same U.S.-Leg width = Section width plus 3/16")	A,C,RB, S,U,W — 4 5/8 T — 4½ K — 4 13/16 CB, RR — 5 CP, N, P, R — 5 1/8 F — 5¼	A,C,RB, S,U,W — 6 5/16 T — 6¼ K — 6 9/16 CB, F — 6 5/8 R, US — 6¾ N — 6 13/16 RR — 6 7/8 CP, P — 7	A,C,RB, RR, S,T,U,W — 8 K — 8 5/16 CB — 8 3/8 N — 8 7/16 F — 8½ US — 8 9/16 P, R — 8 7/8 CP — 9	A,C,RB, S,U,W — 9 11/16 N — 9 CB, T — 9¾ K — 10 1/16 R — 10¼ F — 10 5/16 US — 10 3/8 RR — 10 5/8	A,C,RB, S,T,U,W — 11 3/8 K — 11 13/16 CB, N, R — 12 F — 12 1/8 RR — 12½ CP, P — 12 5/8
HEIGHT IN.	SQ. FT. PER SECTION, CATALOG RATING				
38	3[1]	4¼[8]	5[8]	6[18]	7½[23]
37		4[9]	5[9]	6[9]	
36	3½[2]	4¼[2]	5[2]	6[19]	6¾[30]
32	3[3]	3½[11]	4⅓[11]	5[20]	6¼[24]
30	3[2]	3½[2]	4⅓[2]	5[19]	5½[31]
26	2⅓[4]	2¾[10]	3½[14]	4[21]	4¾[25]
25	(a)	(a)			
23	2[5]	2½[12]	3[15]	3½[22]	4¼[32]
22	2[6,a]		3[16]		4[26]
21½					3 2/3[34]
20	1¾[7]	2¼[13]	2⅔[17]	3[21]	3 2/3[27]
19	(a)				
18½					3[34]
18			2½[6]		3½[33]
17					3[28]
16½					3[2]
16					3¼[6]
15½					2½[34]
14					2½[29]
13½					2½[2]

[1] 3 1/3 for RR. Not available from N,R,US,CB.
[2] N,R,CB only.
[3] 2¾ for RR. Not available from N,R,US,CB.
[4] Not available from US.
[5] Not available from RR,US,P, CP.
[6] RR only.
[7] Not available from RR,US.
[8] Not available from R,N,US,-CB.
[9] US only.
[10] All manufacturers listed.
[11] Not available from N,R,CB.
[12] Not available from P,RR,CP.
[13] 2 for US.
[14] 3.4 for US. Not available from CB.
[15] 2.9 for US. Not available from P,RR,F,CP.
[16] P and RR only.
[17] 2.5 for US.
[18] Not available from P,R,US, CB.
[19] R and CB only.
[20] 5.1 for US. Not available from R,P,CB,CP.
[21] Not available from P,CP.
[22] 3.4 for US. Not available from P,RR,T,CB,CP.
[23] Available only from P (7½) and RR(7).
[24] P only.
[25] Available only from N(4¾), R(4¾), P(5), RR(5), CB(5).
[26] Available only from P(4), RR(4¼), CP(4).
[27] 3¾ for RR. Not available from P,US,CP.
[28] 3¼ for F. Not available from R,RR,US,N,CB,CP.
[29] 2¾ for RR; 2 2/3 for F. Not available from R,US,N,CB.
[30] 7 for CB. N,R,CB only.
[31] 6 for CB. N,R,CB only.
[32] CB only.
[33] RR(3½) and CP(3) only.
[34] W only.
[35] Obtainable from either Federal Radiator Co. or Burnham Boiler Corp.
[a] See Table 2.

The table can also be used to obtain the section width of the various make radiators. In the third horizontal column to the left, information is given regarding those radiators which have a leg width other than the section width. Unless noted, all radiators have the same width at the leg as that of the section. The information shown explains, for example, that A (American Radiator) radiators have a leg width 1/8 in. wider than the section width. F (Federal) radiators have a leg width 1/8 in. wider than the section width for the 3-tube and 4-tube models, other sizes of this make being the same dimension at both leg and section. US (United States) radiators have a leg width 3/16 in. greater than the section width.

KEY TO TABLE 1

	MANUFACTURER	*TRADE NAME*
A	*American Radiator Co.*	*Corto*
B	*Burnham Boiler Corp.*	*Burnham*[35]
C	*Crane Co.*	*Crane*
CB	*Columbia Radiator Co.*	*McKeesport*
CP	*Crouse-Pope Foundry*	*Empress*
F	*Federal Radiator Co.*	*Ferro*[35]
K	*Kohler of Kohler*	*Kohler*
N	*National Radiator Corp.*	*Aero*
P	*Pierce, Butler & Pierce Mfg. Co.*	*Eastwood*
R	*Republic Radiator Co.*	*Oriole*
RB	*Richardson & Boynton*	*Richardson*
RR	*Richmond Radiator Co.*	*Richmond*
S	*H. B. Smith Co.*	*Smith*
T	*The Thatcher Co.*	*Gothic*
U	*Utica Radiator Co.*	*Utica*
US	*United States Radiator Corp.*	*Capitol*
W	*Weil-McLain Co.*	*Cameo*

Table 1 can also be used to select radiators, to size them on drawings or layouts, and has the advantage of containing in a small space, dimensional and capacity data for the 17 makes. Perhaps its most valuable use is to locate a radiator of odd size not made by the manufacturer whose catalog can be readily found.

An example of the use of this table may serve to describe it better than a detailed description. Assume that we are to select a radiator whose length is to be between 50 in. and 56 in., height 29 in. to 32 in., width not over 8½ in., and a capacity of 90 sq. ft.

Dividing the length by 2½ in., the length of one section, we find that we will need from 20 to 22 sections. Dividing the capacity (90) by 20 and by 22, we find that we will require from 4 sq. ft. to 4½ sq. ft. per section.

The heights of the radiators are given in the vertical column to the left, and opposite the heights 30 and 32, we find that a five-tube radiator is the only one satisfying our conditions. In other words, we can use a 30-in. radiator with a capacity of 4 1/3 sq. ft. per section, or a 32-in. radiator with the same capacity. Under the 32-in. model, we find a reference to footnote 11, which tells us that this model is available from all manufacturers except N, R, and CB. In other words, we can use a five-tube, 32-in., which can be supplied by all companies except those just listed. Footnote 2 tells us that the five-tube 30-in. model can be obtained from N, R, and CB only. Thus, we can obtain a radiator to satisfy our requirements, exclusive of width, from all manufacturers with a choice of two heights.

In the five-tube column under the width of section, we find that models of the five-tube, 30-in. or 32-in. radiator, 8½ in. in width or less, are obtainable from all manufacturers except four: those made by American, Crane, etc., have a width of 8 in.; that by Kohler 8 5/16 in.; that by Columbia 8⅜ in.; National, 8 7/16 in.; and Federal, 8½ in. Those made by the other four manufacturers are of a greater width than we desire. One rather interesting point noticed when the table was completed was that the capacity, as rated, of tubular radiators is directly proportional to both the number of tubes and the height. It may aid the estimator at some time when attempting to determine roughly the amount of surface in a building to remember that the capacity of a tubular radiator is equal to the number of tubes multiplied by the height (in inches) divided by 36. The error in one case is 13% but in most cases will be less than 5%. The error in the formula in all cases is less than the difference in capacity as rated by different manufacturers.

Perhaps the most striking point brought out by the data as assembled in Table 1 is the relatively wide variation in section width of different make radiators, although the rated capacity is the same. This difference in width with the same capacity is in one case as much as 16%.

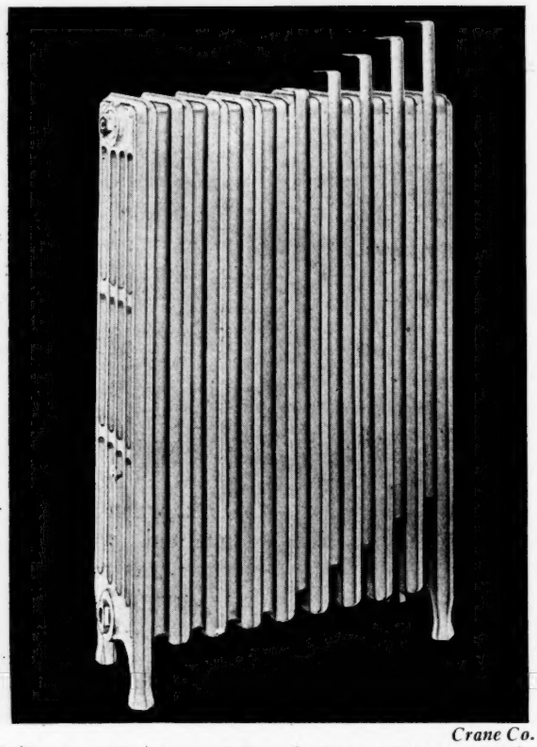
The table will apply in all cases except where the junior type tubular radiator is to be used. The junior model resembles the standard type in every way except that it is considerably more slender with a smaller dimension between sections. A comparison of the senior and junior types is shown in Fig. 2.

Table 2 summarizes the dimensional and capacity data for the junior type radiators made by three manufacturers. All have a length per section of 1½ in.

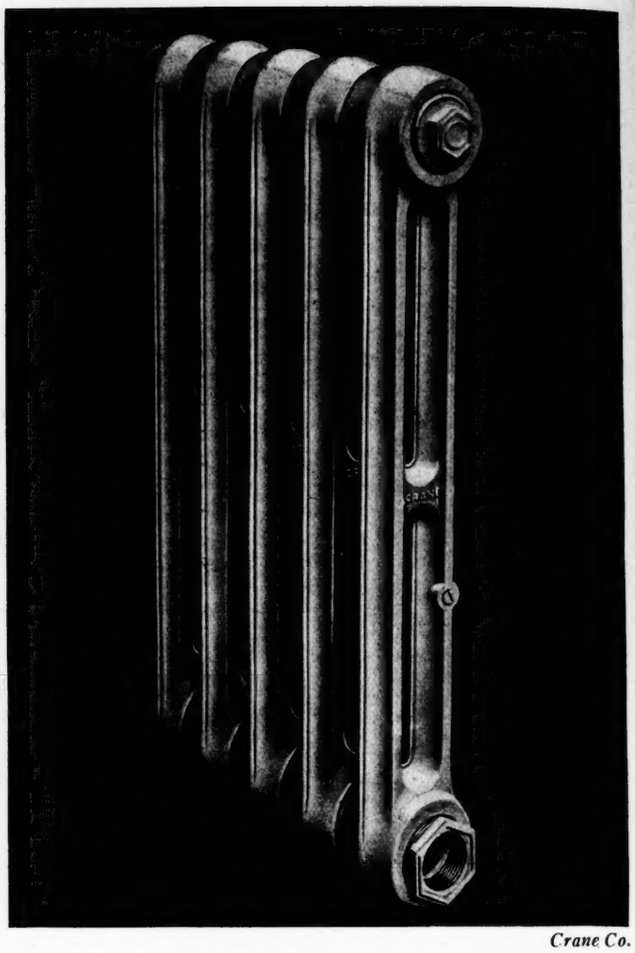
It has been recognized for years that the radiator, so-called, actually gives off the greater part of its heat by convection and, consequently, strictly speaking, is not primarily a radiator. It has been claimed that the convected heat from the ordinary radiator rises rapidly and is responsible for the accumulation of heated air in the upper part of the room. To overcome this, a new type of direct radiator appeared about five years ago, said to give off a large percentage of heat in the form of radiant energy, which is utilized in the lower and occupied portion of the heated space. The front of the radiator, that is, the

	3-TUBE AMERICAN 3-TUBE BURNHAM 2-TUBE WEIL-McLAIN		4-TUBE AMERICAN 4-TUBE BURNHAM 3-TUBE WEIL-McLAIN	
	LENGTH PER SECTION ALL MODELS 1½ INCHES			
HEIGHT IN.	WIDTH, IN.	SQ. FT. PER SECTION	WIDTH IN.	SQ. FT. PER SECTION
25	AMERICAN 3½	1.5	AMERICAN 4 3/4	1.8
22	WEIL-McLAIN 3½	1.3	WEIL-McLAIN 4 3/4	1.6
19	BURNHAM 3	1.1	BURNHAM 4 7/11	1.4

Table 2. Data on junior size tubular radiators



Crane Co.



Crane Co.

Fig. 3. (Above) Invisible radiator shields, which fit into grooves cast in the sections of the radiator. Fig. 4. (Right) A sectional type of wall radiator.

part facing the room, appears as an unbroken surface, while the back is made up of flues to aid the convection currents. This type of radiator is made by three manufacturers†. Two examples of this type radiator are shown in Figs. 6 and 7.

The three types of radiators just described—the junior and senior tubular, and the radiant type heater —make up the greater part of the direct radiator business. There remain, however, the wall radiators largely used in basements, toilets, or other similar rooms.

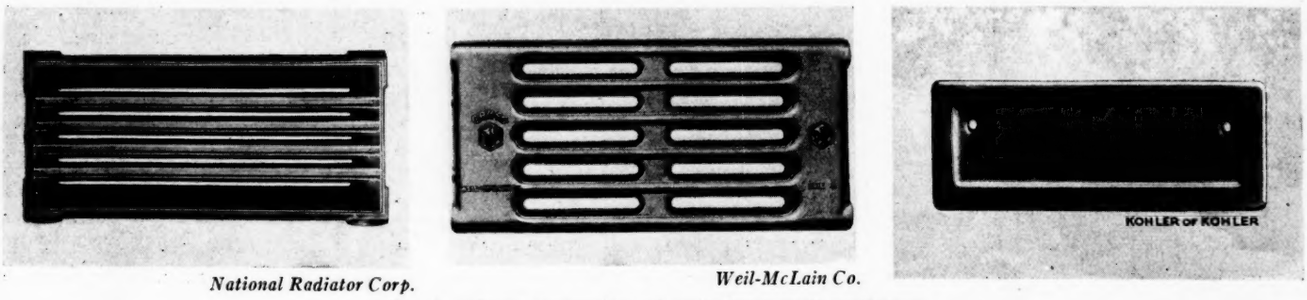
Wall radiators are available in two quite distinct types. Three of these illustrated in Fig. 5 consist of a one-piece unit. Additional capacity is obtained only by fitting together a number of these units, each unit having ordinarily from 5 sq. ft. to 9 sq. ft. capacity. The second type, and one which has come into use more recently, is the ordinary tubular-type radiator made without legs and which is hung on the wall or ceiling. This type is illustrated in Fig. 4. This arrangement permits of slightly more flexibility than the unit type, but on the other hand, extends farther out into the room.

†American Radiator Co., U. S. Radiator Corp., and National Radiator Corp.

The dividing line between the radiant-type radiator and the convector is not a sharp one. Recently, types have come into common use in which the back part of the unit is designed to aid the convection currents, while the front is designed particularly for throwing off radiant heat. In other words, they are more or less variations of the radiant-type radiator described, with possibly more attention paid to the convection feature.

Fig. 3 shows a direct cast-iron radiator designed for ordinary use, but adapted to a particular purpose, in that it can be used with shields to deflect the convection currents and prevent, to a large extent, the rub of these currents along the draperies and walls. The shield is said to deflect the heated air out into the room and is also said by this means actually to result in fuel economy. The shields which fit between the sections into grooves cast into the sections, are made of pressed steel, and are held in place by a groove or bed.

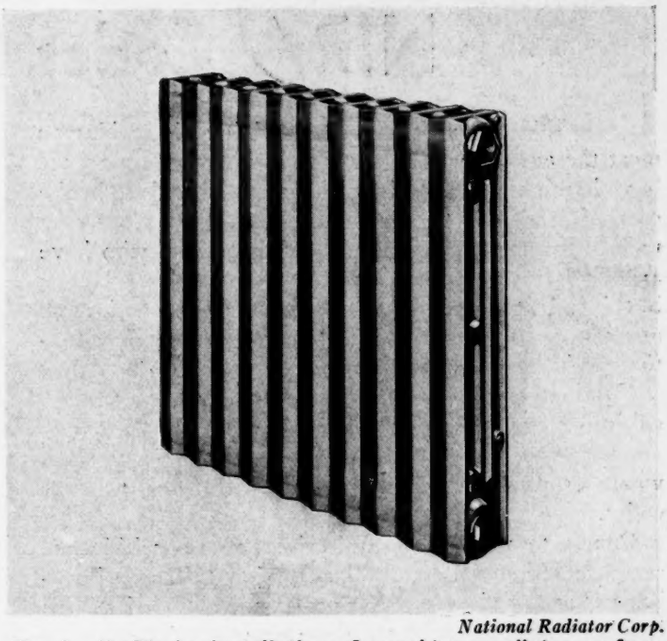
The most popular method of heating industrial build-



National Radiator Corp. *Weil-McLain Co.*

Fig. 5. Three examples of unit type wall radiators

American Radiator Co.



National Radiator Corp.

Fig. 6. (Left) An installation of panel-type radiator surface.
Fig. 7. (Above) A one-tube panel-type radiator, which gives off a large portion of heat in the form of radiant heat.

ings is by the use of unit heaters, which consist of an extended surface over which air is forced by means of a motor-driven fan. Previous to the introduction of these units, pipe coils were commonly used. One company has made an improvement on the pipe coil, both from the standpoint of heat emission and appearance. This consists of elliptically-shaped (in cross-section) iron tubes with the major axis of the ellipse in a vertical position. These units weigh approximately 2 lb. per sq. ft. This unit is another example of those types which are on the border line between radiators and convection units, in that the purpose of the elliptical tube is to permit more free travel of the convection currents.

One of the earliest attempts of the radiator heating industry to meet the demands for air conditioning and to overcome the competition of the warm-air furnace which had the advantage of being able to humidify the air, was the introduction of humidifying radiators by several companies‡. Fig. 9 shows one of the more recent of these units, which is more or less unusual in that the radiator itself has been but little changed. As shown in Fig. 8, the top of the radiator is cast in the form of pans to hold water, which is evaporated by the application of heat. Other types on the market include those in which the water overflows from the pan on the top to a pan below, which in turn overflows to pans further down. The one illustrated is available by sections, and permits of considerable flexibility in the selection of sizes.

‡Among these are the American Radiator Company's Ideal Cascade humidifying radiator; Richardson & Boynton's Humid-Heat, and The Crouse-Pope Humi-Rad.

Kohler of Kohler

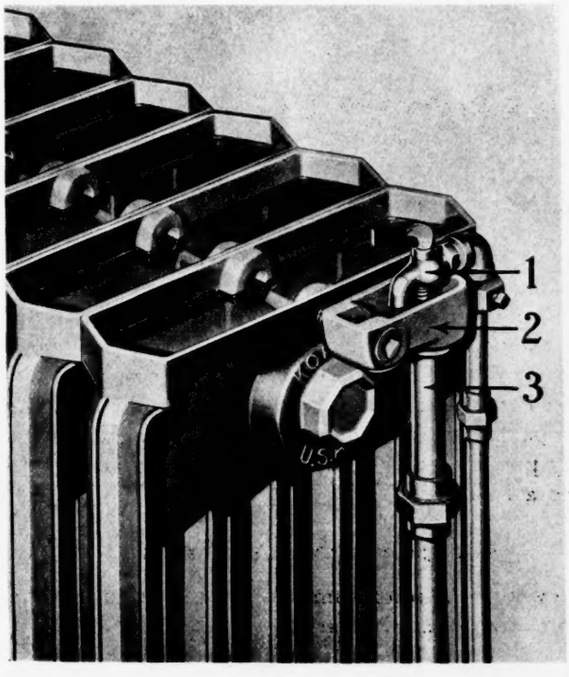
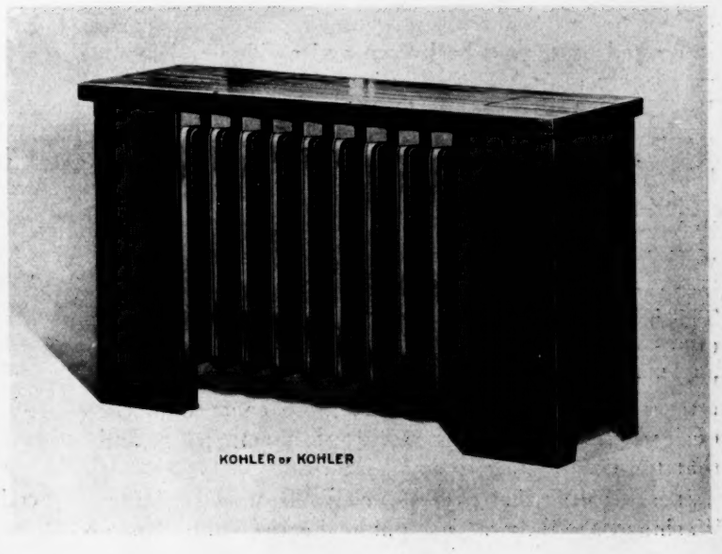


Fig. 8. (Left) Detail of humidifying radiator shown in Fig. 9 (Below).



NIRA Codes Make Progress

DURING the past few weeks while code-making to meet the appeal of the President has been going on, we have had a number of inquiries as to procedure in the case of readers who are in the dark as to their own part in the movement, and also from others who have asked what is now being done by the trade associations in this industry and its allied lines. In order to furnish answers to these inquiries we have canvassed the situation and the resulting information is made available.

Our information is that professional groups are not subject to the terms of the Recovery Act and that they are not expected to submit codes. We know of no cases where professional groups have drawn up fair practice codes.

Contractors doing a local business wholly within one state, retailers, dealers, local agents, and others of similar nature, are in a peculiar position. If their business is wholly within one state there seems to be question as to whether any of the provisions of the Recovery Act apply to them. The title states that the act deals with interstate and foreign commerce. On the other hand a number of retail and distributor trade associations have drawn up codes. To date, no such codes have reached a public hearing and there is no case at hand to use as a guide in learning what the attitude is to be. If a contractor organization draws up and submits a code it would seem that the group has done all it can to meet the appeal. Thereafter the course to be taken will depend on developments. Contractors, distributors, agents, and others who do business in more than one state would be involved in interstate commerce. Whether buying for resale or for a contract job will be construed to bring all contractors under the Act remains to be seen. Contractor and dealer codes under preparation assume that this is the interpretation which will be put on the law.

We have been asked if a code drawn up by a certain group can be put into effect without all interested parties knowing of it. We believe this is possible, but provision is made to prevent it by requiring a public hearing at which supposedly all interested parties have a right to be heard. There is no guarantee that every interested party will be known and notified. To some extent you must keep in touch yourself. HEATING AND VENTILATING has arranged to follow these announcements as closely as possible and on request will be pleased to notify readers by mail of hearing dates.

Nearly all codes made public so far have contained little except statements of minimum wage, maximum work hours, the several declarations required to be put into each, and a brief statement of fair trade practices. This is the material which the NIRA urges be included. Other subjects may be included later. Every group which presents a code must offer evidence that it represents a substantial part of all those engaged in the business, that it does not restrict its membership, and that the code is fair to small interests.

It is reported that over 400 codes are now on file in Washington. Only a few public hearing dates have been fixed, and still fewer codes have come through the mill. Rumor has it that it is quite likely to be several months before hearings will be reached on codes presented by groups representing our industry and its interests. The announced policy is to give those codes dealing with basic commodities the right of way. The code-drawing phase is rapidly passing.

Codes for Our Industry

Within our own industry there is a tendency for groups to act and submit codes independently. Many of these have either been fully completed and filed or are virtually finished and awaiting filing at Washington. Not only are most of the older, established associations submitting codes, but a number of new associations have been organized to do so. Nearly all codes seem to be prepared in conference or by committee and with advice of counsel.

As opposed to this tendency toward independent group action some moves are being made looking toward a single comprehensive code. Notable is that of the National Association of Master Plumbers which has drawn up and approved a code which covers manufacturers, wholesalers, contractors, and retailers. Codes of this general kind meet with the ideas of the government officials who would like to deal with a few comprehensive codes rather than with a lot of isolated ones.

What will come of these two tendencies between now and the time when the codes come up for official action is one of the points of interest. Supposedly, each group is to get a free chance to draw up a code to govern itself and the administration has announced that it prefers to adopt a hands-off policy. If this attitude continues then the only way that the advocates of one big code can draw the others in is to "sell" the idea. If, however, the administration brings pressure to bear to force comprehensive codes then it is questionable how sturdily the smaller groups will insist on their right to present their own independent codes.

A second tendency worth noting is that there is a great deal of just plain jockeying for position going on. This is perfectly natural, and to be expected. Some groups would like to use the code preparation as not only a means of establishing fair practice but as a means of laying hold of control of as much business as possible. Natural rivalries between organized groups are also in evidence and, if precedent in other industries holds, they will break out into the open at the public hearings. With air conditioning not yet moving in established trade channels there are likely to be attempts on the part of several groups to "adopt" it. Also much secrecy prevails—usually a good sign that there is subsurface activity.

Groups Which Have Codes

Following is a brief summary of the status of the code-preparation activity as we go to press:

(Continued on page 33)

Calculation and Design of Mechanical Warm-Air Heating Systems

PART 1

By J. DONALD KROEKER†

WARM-AIR heating with forced circulation has gained wide acceptance because of its flexibility, positive circulation, and higher efficiency. It has been hampered, however, by the fact that each installation, if properly designed, constitutes an engineering problem.

A number of attempts have been made to simplify methods of calculation and inaccurate rules-of-thumb have been advanced and are widely used. Also, new systems of distribution have been introduced in order to avoid design difficulties. However, all have fallen short of proper design in their disregard in one way or another of the fundamentals of air movement.

In September, 1932, the National Warm Air Heating Association issued its "Tentative Code for the Installation of Mechanical Warm-Air Furnaces in Residences." While this code is a step in the proper direction and away from the first very inaccurate methods, its sponsors do not claim that it presents either the ultimate or the most desirable method, but state that it is "intended to serve until such time as a final and more precise code for mechanical warm-air furnace heating is evolved." A more precise method is presented here.

In general, the right and logical method of designing systems for moving air, seems to be the pressure-loss method. It is unnecessary, however, to know all the ramifications of detail of this method, for any one who confines his design activities to residential or other installations in which comparatively small volumes of air are moved.

To present the pressure-loss method without going into the finer details and to make the essential calculations much simpler without deviating from accuracy is the purpose of this article. This method is outlined and exemplified particularly as it applies to systems in which the heating plant is located either in a basement or on a first floor.

†Montag Stove & Furnace Works, Portland, Ore.

Procedure of Design

FIRST. Obtain prints of building floor plans or make sketches accurately to scale. Show locations of supporting beams in basement and whether they are below or in the joists. Show direction, spacing, and size of joists, all immovable objects, windows, doors, and, if

DATA SHEET

MR. JOHN DOE — Residence in Pittsburgh, Penna. — Date 9-15-32

CONTRACTOR—J. J. RILEY CO. — Calc. by j.d.k.

No.	Space	Size	Glass 1.13	Wall .247	Ceil. .260	Infiltrn. 35	Heat Loss B t.u. per hr.	Preliminary Air Vol. c.f.m.	Preliminary Area Sq. In.	Corrected No.	Corrected Air Vol c.f.m.	Corrected Area Sq. In.	Corrected Size In	Riser Size In.	Returns Air Vol. c.f.m.	Returns Area Sq. In.	Returns Size In.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1	Laundry and Heater Room—	No Heat															
2	Playroom	13x14x7	24	196			3,940	52	30	1	61	35	12x5		100	40	12x6
3	Workshop	14x11x7	22	111			2,800	37	21	1	43	25	10x5				
4	Fruit Room—	No Heat															
5	Living Room..	18½x13x9	104	278		84	18,450	240	135	2	260	150	2–14x8		260	110	4x4x30
6	Hall	7x11x9	45	155	75	20	8,890	115	67	1	135	77	14x8		250	110	4x4x30
7	Kitchen	11x11½x9	18	126			3,600	47	27	1	55	31	12x5				
8	Nook	6x6x9	18	144	36		4,570	60	35	1	75	43	14x5		290	120	4x4x30
9	Dining Room..	14½x13x9	62	185		38	10,560	138	79	1	160	92	14x8				
10	Bedroom No. 1	18½x13x8	55	285	240	74	18,440	240	130	2	260	150	2–14x8	2–3½x12			
11	Bedroom No. 2	11x13x8	28	164	143	18	8,810	115	66	1	133	78	14x8	3½x12			
12	Bedroom No. 3	11x9x8	28	132	99		6,290	82	48	1	96	55	10x8	3½x10	350	150	8x5x30
13	2nd Fl. Hall—	Included in No. 6															
14	Bath	7x8x8	8	44	56	14	3,310	44	25	1	51	30	10x6	3x10			
	Totals						89,660				1329						

RESISTANCE

WA Registers, Vel. = 250 f.p.m.,	.008
WA ducts	.042
Furnace, filters, washer,	
CA ducts	.030
CA Registers, Vel. = 350 f.p.m.	.012
Total	.092

HEAT REQUIRED

c.f.m x 60 x C_p x T_r

1329 x 60 x 0.0185 (140-65)

—110,000 B.t.u. per hr.

SPECIFICATION

Heater—No. 3 Blank furnace, certified output, 120,000 B.t.u. per hr.

Blower—Included.

Filters—Included.

Motor—110 volts, 60 cycles. 1725 r.p.m.

Fig. 1. Sample Data Sheet

possible, preferred location of chief articles of furniture.

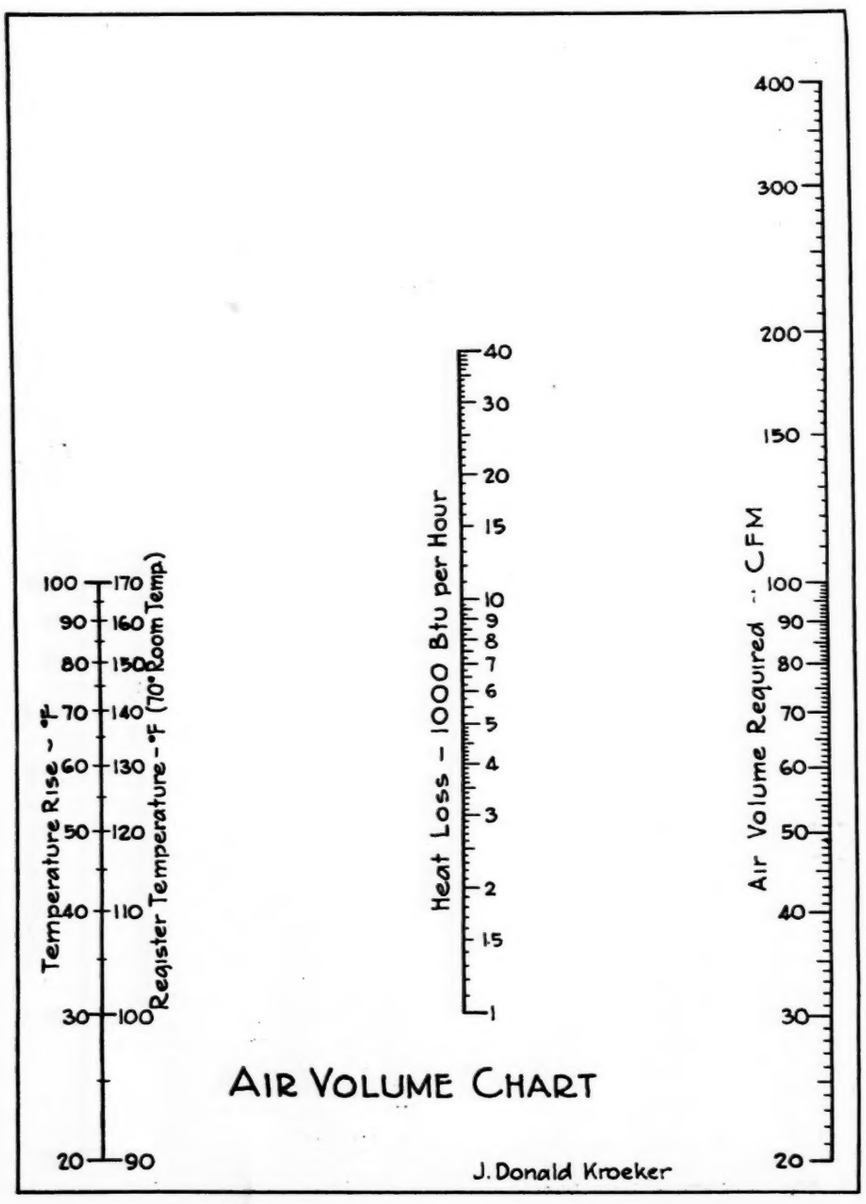
Indicate the north point and the direction of prevailing winter winds, unusual exposures, if any, and rooms in which no heat is required. Make notes of construction of walls, ceilings without heated rooms above, exposed floors, and windows; what, if any, insulation has been or is to be applied, and the temperature to which the various rooms are to be heated.

SECOND. Calculate the hourly heat loss in B.t.u. per hour for each room. It is preferable to calculate infiltration from length of crack in wall openings and wind velocity rather than to assume arbitrarily a certain number of air changes by infiltration. Tabulate the results as in column 8 in the sample data sheet, Fig. 1.

THIRD. Select the register temperature to be used from Table 1. (140° is commonly used for residences today, although the tendency is toward lower register temperatures.) Determine the air volume in cubic feet per minute required for each room from the formula, c.f.m. $= \frac{\text{Hourly Heat Loss}}{60 \times T_d \times C_p}$, where T_d is the difference between register and room temperatures, and C_p is the specific heat in B.t.u. per cubic foot per °F. This calculation may be made by means of Fig. 2, the "Air Volume Chart." To use this chart, place it on a flat surface, stick a pin into the left-hand scale at the register temperature or temperature rise (T_d from the above formula) selected, and, using this as a pivot, move a straight-edge up along the center scale to the heat loss, and on the right-hand scale read the air volume required. Tabulate as in column 9 of the sample data sheet.

TABLE 1
REGISTER TEMPERATURES AND AIR VELOCITIES

Type of Building	Register Temp. °F.	Velocity (f.p.m.) In Horizontal Ducts	In Riser Ducts	Through Registers: Baseboard or Wall to 6 ft. above floor	Through Registers: In Wall, 6 ft. or more above floor
Residences ..	100-140	to 1000	to 600	to 300	to 800
Schools	to 120	to 800	to 600		to 300
Churches	90-120	to 900	to 600	to 300	to 800
Auditoriums.	80-120	to 1000	to 600	300-500	to 800
Garages and Ind. Bldgs...	80-140	to 1400	to 1000	to 600	to 1000


Temperature Rise - °F
Register Temperature - °F (70° Room Temp)
Heat Loss - 1000 Btu per Hour
Air Volume Required - CFM
AIR VOLUME CHART
J. Donald Kroeker

Example: To obtain the air volume required for the master's bedroom, Fig. 5, (room No. 10 on the data sheet) stick a pin into the left-hand scale at 70° temperature rise or 140° register temperature; then pivoting on this, move the straight-edge up along the center scale to the heat loss recorded in column 8 of the data sheet—18.5 (since the heat loss is 18,500, the scale being in 1000 B.t.u. per hour) and read the air volume required on the right-hand scale; namely, 240 c.f.m. For room No. 2, this is 115 c.f.m., etc.

If, in this example, the room temperature to be maintained had been 60° instead of 70° and the register temperature the same, or 140°, the temperature rise, T_d, would have been 140 less 60, or 80°, and the air volume for the master's bedroom would have been 210 instead of 240 c.f.m.

FOURTH. Select the velocity desired at the registers from Table 1. Calculate the free area required in the

Fig. 2. Air volume chart for calculating the volume of air required in the system.

registers to each room by the formula: area (sq. in.) $= \frac{144 \times \text{air volume (c.f.m.)}}{\text{velocity (f.p.m.)}}$. This may be done mechanically by means of Fig. 3, the "Duct Area Chart," in which the velocity is given on the right-hand scale, air volume in the center, and area on the left-hand scale. Use the chart exactly as the one described in the third operation and tabulate the values obtained as in column 10.

Example: The register velocity to be maintained is 250 f.p.m. Then, for the master's bedroom, the free area required in the register is 125 sq. in., for room No. 2, 67 sq. in., etc.

Determine the number of registers required for each room. This may be done by inspection of the required register areas in column 10. Tabulate as in column 11.

FIFTH. Select and indicate the locations of all warm-air registers on the prints or sketches of floor plans. Select and indicate locations of return air openings. If possible, return air openings should be placed in the windward sides of rooms, (at outside walls for the usual installation) and as nearly at the foot of open stairways as possible, to prevent drafts of cold air across floors.

SIXTH. Make a tracing of the basement plan and show locations of all warm-air risers and all returns.

SEVENTH. On this tracing sketch a skeleton of the complete piping system necessary, connecting all warm-air risers and all returns. See Fig. 7.

EIGHTH. Due to the fact that heat is lost from the warm-air ducts into the surrounding space, recalculation will now have to be made of the volume of air to be delivered to risers which are at some distance from the furnace.

Heat loss into the surrounding space takes place continuously. This results in a reduction of the temperature of the air in the ducts and, therefore, a reduction in the register temperature, and means that more air will have to be supplied through the register to deliver the same amount of heat into a given room.

The amount of heat lost in this way depends chiefly on four things; namely, (1) difference in temperature between the air in the ducts and that of the air and objects outside the ducts; (2) amount of surface exposed by the ducts; (3) nature of the duct surfaces, and (4) kind and amount of insulation.

The reduction in temperature of the air in the ducts may be determined by calculation for *each foot of length* from the following general formula for round ducts, which will be satisfactory for use also on most rectangular ducts:

$$t = .059 \frac{F \times t_d}{C_p (C_m \times V_m)^{1/2}}$$

in which t is temperature reduction in °F.; C_p is specific heat of air at constant pressure (use 0.0185); C_m is volume of air passing through the duct c.f.m.; V_m is velocity of air in the duct in f.p.m.; t_d is the temperature difference inside and outside of the duct at the 1-ft. section in question, and F is a factor depending on duct surface and insulation and is expressed in B.t.u. per square foot per °F. per hour. Some values of this factor as determined at the University of Illinois (reported

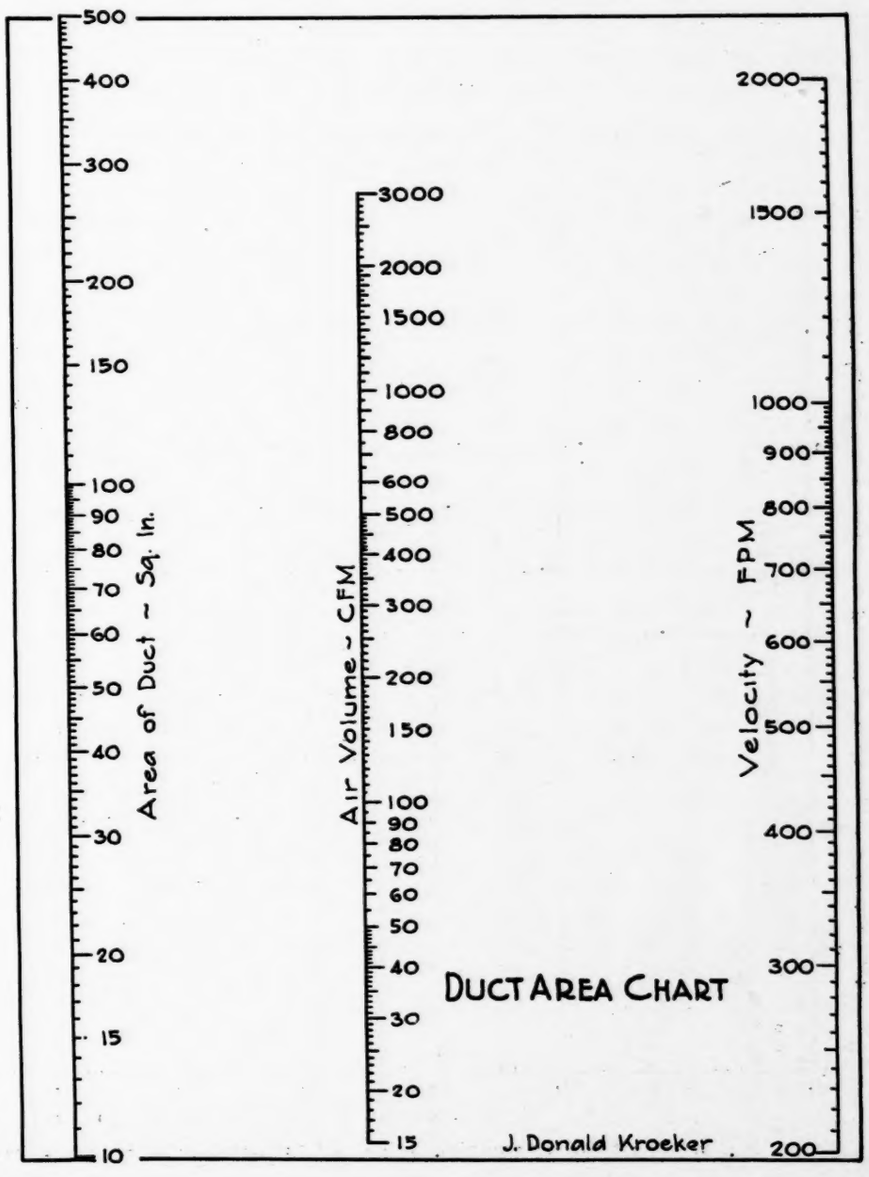
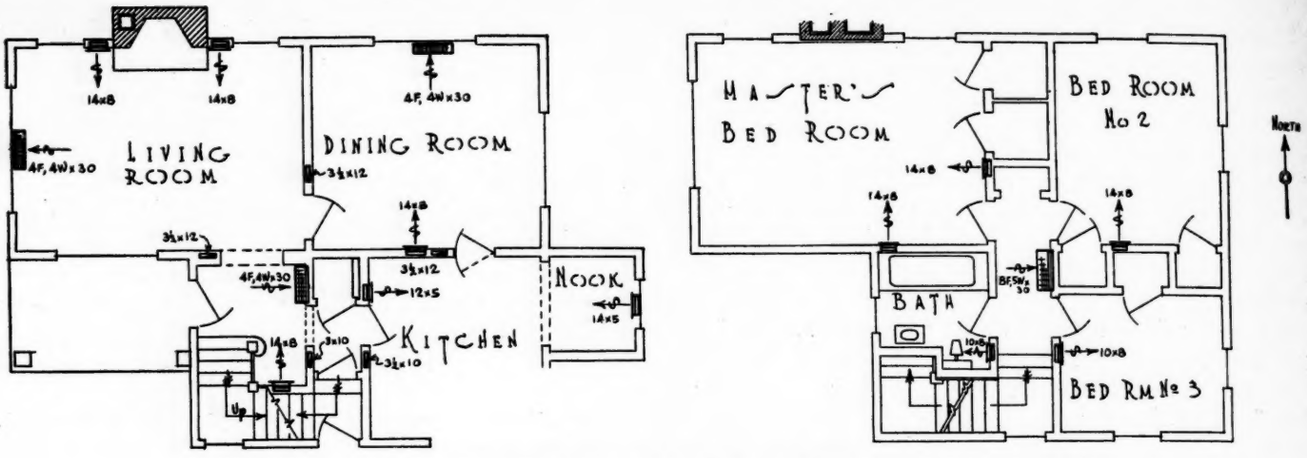


Fig. 3. Duct area chart for determining the free area for the room registers.



Figs. 4 and 5. First and second floor plans of the building chosen as an example

in Bulletin No. 120) are as follows:

No.	Description	F
1.	IC tin, bare and new	1.28
2.	IC tin, dusty	1.44
3.	IC tin, 1 thickn. air cell, 1 of 12-lb. asbestos	0.870
4.	IC tin, 3 thickn. air cell, 1 of 12-lb. asbestos paper	0.565
5.	IC tin, 1 thickn. 10-lb. asbestos paper	2.080
6.	28-ga. galv. iron, bare and new	1.33
7.	28-ga. galv. iron, 3 thickn. air cell, 1 of 12-lb. asbestos	0.577
8.	28-ga. galv. iron, 1¼-in. block asbestocel	0.326

To determine the true register temperature accurately, the formula must be solved for each foot of length. Sufficient accuracy will result, however, from use of values in Fig. 6, which are set up for a velocity of 600 f.p.m. and an air volume of 600 c.f.m. Since the temperature loss varies only to a minor degree with both volume and velocity (for 600 f.p.m. and 1000 c.f.m. it is approximately 5% less) this chart may be used also for volumes and velocities other than those for which it is especially designed, without introducing any inaccuracies of moment.

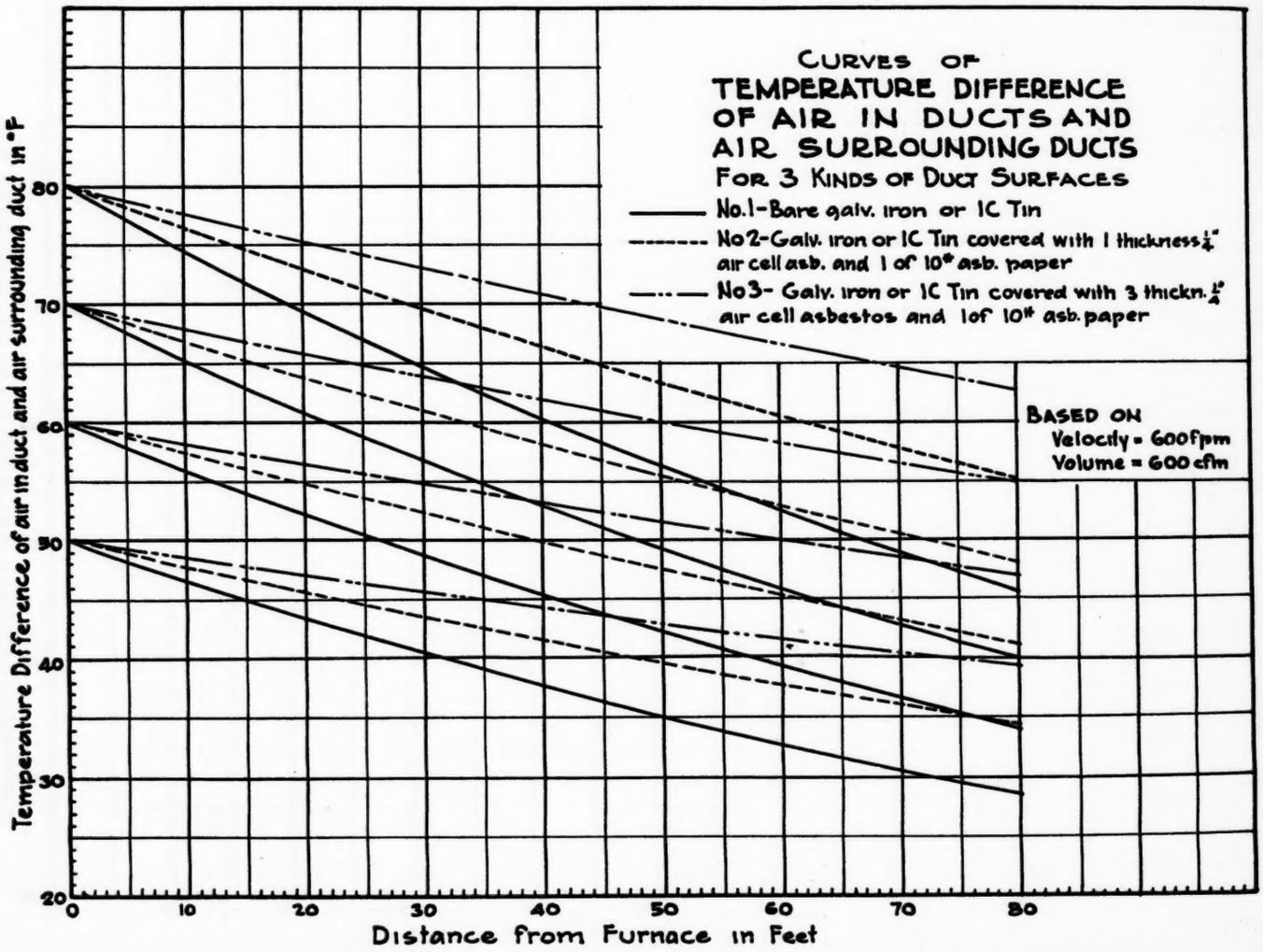


Fig. 6. Chart for determining actual air temperature after it has traversed a given length of duct

Use of Fig. 6. If the register temperature to be used is 140° and the basement temperature is 60°, the temperature difference near the furnace will be 80°. If the ducts are made of bare galvanized iron or tin, the temperature difference 10 ft. from the furnace will be only 74½° according to the chart. This is obtained by following the 10-ft. line at the bottom of the chart up to the intersection of this line with the solid line beginning at the left at 80°, and reading the temperature difference at this point in the duct at the left. A riser taking off the trunk duct 10 ft. from the furnace will, therefore, deliver air at a register temperature of 60 plus 74½, or 134½°, instead of 140°. So the amount of air to be supplied at this riser must be recalculated with this new register temperature.

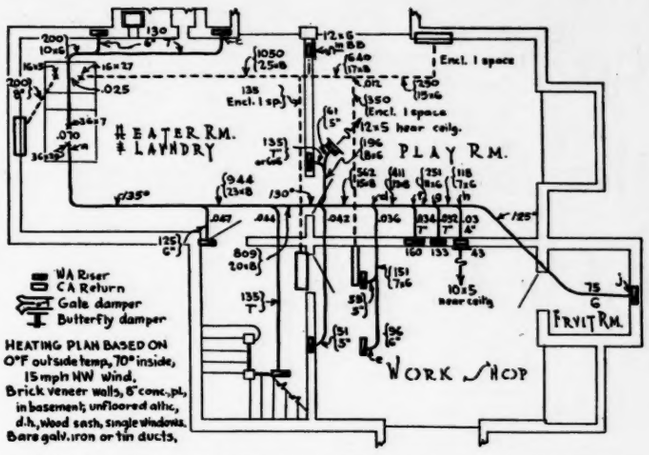


Fig. 7. Skeleton layout of duct system in basement

A simple method of using the information on this chart is to indicate on the skeleton made in the seventh operation, the temperature of the air in the ducts to the nearest 5°. Thus, starting with 140° air at the furnace and using bare ducts, the register temperatures in the illustrated example following will be:

140° at the furnace and out 8 ft. (follow the 75° horizontal line to the solid line starting at 80° and read the distance from the furnace where these lines intersect).

135°, 9 to 18 ft.
130°, 18 to 28 ft.
125°, 29 to 40 ft.
120°, 41 to 55 ft.

Having indicated the actual register temperatures which will apply, as in Fig. 7, recalculate the air volumes where necessary and enter the results in a table as in column 12.

No temperature loss need be figured for enclosed risers above the basement, providing they pass through or between heated spaces and are less than 25 ft. long.

NINTH. Recalculate register free areas where necessary and tabulate as in column 13. Select register sizes from the required free areas listed in column 13 and tabulate as in column 14.

TENTH. Determine sizes of risers from a velocity which will be used in all risers. This velocity may be determined from the riser which is the maximum standard size and is to carry the greatest volume of air. Thus, in the example following, if a 3½ in. × 12 in. riser is to be used in the second register in room No. 6, the velocity in it will be 460 f.p.m. This is determined by means of Fig. 3 by aligning the area, 42 sq. in., on the left-hand scale, and air volume, 135 c.f.m. on the middle scale, and reading the velocity on the right-hand scale.

By further use of Fig. 3 and this same velocity, determine the areas required in the other risers and specify commercial riser sizes at least equal to these areas. Tabulate as in column 15.

ELEVENTH. Indicate at each riser on the tracing of the basement plan made in the sixth step, the amount of air to be supplied to that riser and in each basement duct the amount of air it must carry. See Fig. 7.

We are now ready to proceed with the calculation of the duct sizes. This will be explained in the concluding article, which will appear next month.

NIRA Codes Make Progress

(Continued from page 28)

American Oil Burner Association has printed a booklet containing its code and its evidence of right to speak for the industry. National Association of Master Plumbers has released a code approved at its recent meeting in New Orleans; contains provisions for dividing industry into 16 divisions with each represented on an executive committee; meetings held to promote idea of a comprehensive code for everyone. A code sponsored by the National Electric Manufacturers Association was among the early ones filed and to reach public hearing; no record of any presidential action on it; original code claimed to cover not only electric but gas-fired kitchen refrigerating machinery; gas-fired omitted on protest at public hearing. Associated General Contractors code filed and made public middle of July; important points: generals shall pay to subcontractors and material men their proportionate share of payments made by owner, and shall not permit subs to finance their accounts. Heating, Piping and Air Conditioning Contractors National Association adopted a code at its convention late in July. A code has been prepared by a joint committee representing seven regional plumbing and heating wholesaler organizations and is now in the hands of members for discussion.

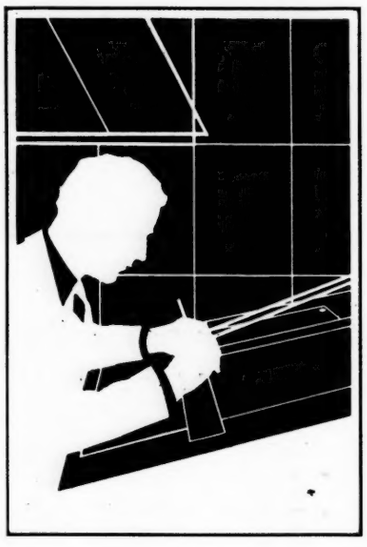
In addition to the above we are advised that each of the following associations has either finished the preparation of a code or is at work on one:

(Concluded on page 50)

Comparison of Two Methods of Selecting the Design Temperature for Heating Systems

A PREVIOUS article[1] discussed three commonly used methods of selecting the design temperature for heating systems. Method (1) was to accept the figure commonly used by engineers in the given locality. Methods (2) and (3) were to select a temperature not more than 15° above the lowest recorded temperature, one of these being that the lowest temperature be the all-time low, the other the low for the previous 10 years. A survey of readers gave figures commonly used in 96 cities, and these figures are referred to in this article as examples of method (1). The conclusion reached was that common practice, as shown by the survey, does not agree with methods (2) and (3).

A fourth method is also in common use. This is the use of standard radiator estimating sheets or tables. The most complete of such methods, hereafter referred to as method (4), at the present time has a table based on the most used heat loss coefficients, and gives the amount of radiator surface required for various quantities of wall and glass surface, roof surface, cracks, etc. The table is calculated throughout on a 70° temperature difference, that is with a 0° outside temperature, a 70° inside temperature, and for radiators emitting 225 B.t.u. per sq. ft. per hr.



In addition to the table, a set of correction factors for a number of large cities is furnished. Each city has eight different factors, one for each of the major points of the compass. To use the table, one determines from the 0°–70° table the amount of radiation required for the given amount of wall or glass area on a given exposure. This figure is then multiplied by the correction factor for that exposure for that city. The result, then, gives the amount of radiation needed to offset the heat loss through that particular construction for the given exposure and the given city.

Thus, the correction factor combines (a) the correction for the amount the outside or design temperature varies from 0°, (b) a correction for the exposure, which includes wind velocity and wind direction.

[1] "Selecting the Design or Outside Temperature for Heating Calculations," HEATING AND VENTILATING, May, 1933, page 33.

Calculations made by those who originally developed this method of computing radiator surface involved a study of weather bureau records for January and February, the two coldest months, for three consecutive years. They concluded, since heat transmission coefficients are based on a 15 m.p.h. wind, and since they agreed that a wind velocity of 1 m.p.h. is equivalent to a 1° drop in temperature, that 15° could be added to the extreme design temperature to arrive at their base temperature. Thus, in effect, this system uses a different design temperature for each exposure, depending on the wind velocity and wind direction, as well as the coldest temperature expected in that locality.

From the foregoing it is seen that it is difficult to determine accurately just what part of the correction factor is design temperature and what part allowance for the wind variable. For purposes of comparison with other methods, however, it was felt that certain assumptions could be made to reduce method (4) to a basis where it could be compared with method (1). The assumptions are:

(A) That method (1) requires use of heat loss coefficients based on a 15 m.p.h. wind.

(B) That, generally, method (1) requires the addition of 15% to the calculated heat loss to the two sides nearest the prevailing wind.

(C) That for an average of a number of buildings, (B) is approximately equivalent to adding 7½% to the heat loss of the four sides of the building.

(D) Or, (C) is equivalent to using a temperature difference 7½% greater than usually used, which is the same as dropping the design temperature so that the temperature difference is 107½% of the usual practice.

(E) The average correction factor for a number of buildings for a given city in method (4) would be the average of the eight exposure factors.

(F) Multiplying the temperature difference of 70° on the first table of method (4) by the average correction factor for a given city gives the temperature difference used in that city if the wind velocity is the same (15 m.p.h.) in all cases. This is not actually the case in method (4), but such an assumption merely

TABLE 1
COMPARISON OF CALCULATED DESIGN TEMPERATURES

	Calculated Design Temperature, Method (1)[1]	Calculated Design Temperature, Method (4)[2]
Albany	−16	−3
Baltimore	−5	14
Birmingham	6	24
Boston	−5	2
Buffalo	−5	−18
Chicago	−16	−6
Cincinnati	−11	2
Cleveland	−5	−7
Detroit	−5	−9
Houston	16	25
Kansas City	−16	−3
Los Angeles	27	42
Louisville	−11	3
Madison	−21	−11
Milwaukee	−24	−6
Minneapolis	−21	−16
New Orleans	22	36
New York	−5	6
Philadelphia	0	−9
Pittsburgh	−5	−3
Portland, Ore.	0	11
Providence	−5	−5
Richmond	6	17
Salt Lake City	−5	19
San Antonio	16	33
San Francisco	27	41
Seattle	6	18
St. Louis	−11	5
Syracuse	−7	−9
Washington	−5	12
Wichita	−11	1

[1]*Includes an allowance for exposure.*
[2]*Corrected for lower heat emission of radiators used in method* (4).

debits the wind allowance and credits the design temperature.

Then, if we subtract the calculated temperature difference from 70° we have the calculated design temperature of method (4) to compare with a calculated design temperature of method (1). The comparison is shown in Table 1.

Examination of Table 1 shows that, of the 31 cities covered, the design temperature in method (4) is higher in 25 cities, lower in 5, and the same in 1, as compared with those by method (1). Assuming that a difference of 3° or less is, for all practical purposes, so close as to be called the same, we find the number of cases grouped as follows:

Where method (4) uses a higher design temperature than method (1):

Degrees higher	No. of cities
4 to 9	3
10 to 15	14
16 to 20	6
21 to 25	1

Where method (4) is lower than method (1):

Degrees lower	No. of cities
4 to 9	2
10 to 15	1
Same	4

The cities where the methods are practically the same are Providence, Pittsburgh, Cleveland, and Syracuse. The city where the methods show the greatest disagreement is Salt Lake City, where method (4) is 24° above method (1). The average calculated design temperature for method (4) of the whole 31 cities is 13° above that of method (1).

The comparison is rather startling. There has been some evidence that method (4) has not always been wholly satisfactory, but on the whole we believe that this method of calculating has been so. Therefore, it is peculiar that so little attention has been paid to the fact that this method results in the installation of about 15% less radiator capacity than other methods.

Conclusions

It was shown in the previous article that methods (2) and (3) do not agree with method (1). Similarly, this study shows the wide variance of method (4) from method (1). In other words, none of the commonly used methods agree with method (1) and, furthermore, although the figures have not been given here, there is no agreement between either methods (2) or (3) and method (4).

Consequently, if the heat loss method of calculating radiator surface has been successful it has been so in spite of the fact that one of the most important figures entering into the calculations—temperature difference—is settled more or less by guess. In this particular study, involving only methods (1) and (4), an examination of our data shows the following:

(A) If we assume that method (1), that of using the design temperature commonly used in a given locality, is correct, then method (4), using the radiation sheets, is either (a) unsatisfactory, or (b) satisfactory, but allowing a factor of safety inversely proportional to the amount of its design temperature is above that of method (1). In the few cases where method (4) has a lower design temperature, naturally it is allowing a greater factor of safety than the other method.

(B) On the other hand, if we assume that method (4) is correct, then method (1) allows too great a factor of safety, resulting in increased and perhaps excessive cost of plant. It is possible that, if this is true, method (1) might well omit the usual addition of allowance for exposure.

Further than these conclusions we cannot go. As pointed out before, method (4) seems to be working satisfactorily. Too, the method of working up the sheets appears to be reasonable and logical. However, the traditional figure used for design in a given city, as exemplified by method (1), is in most cases the result of long years of experience. Contractors have undoubtedly tried raising the figure for competitive purposes, and it seems that if this were done successfully, the higher figure would have finally become generally accepted. Consequently, when engineers or others use method (4) they should realize that this method will result in (usually) less radiator and plant capacity. The selection of the design temperature is not only a matter of theoretical interest, but one of considerable practical significance, particularly in these days of keen competition.

Dust Counting and Air Sampling Apparatus for Field Surveys

By R. C. STRATTON, J. B. FICKLEN and W. A. HOUGH†

MUCH has been written recently by students of public health concerning the relation of the atmosphere in working places to the health of the workers. The examination of the various constituents of the atmosphere of work places has become a necessity of such studies and in an effort to prevent resulting occupational effects upon the workers exposed.

Certain pulmonary diseases have been assigned by some medical authorities as being caused by inhalation of various types of dust and form the major portion of the field being studied. Dust containing certain percentages of free silica, of a definite particle size range, has been designated as the cause of silicosis[1]. The amount of knowledge concerning the part played by various other dusts as causes of other pulmonary changes is constantly being increased. It therefore has become important that any investigator should be able to go to any work place and analyze the air to determine the total number of particles per unit volume and the particle size. The United States Public Health Service[2] has perfected and described an apparatus for accomplishing this. The apparatus described herein is a practical adaption to increase the portability and reliability for use of industrial investigators.

The other materials in air which are of interest are the fumes, dusts, or salts of various metals, principally lead, mercury, and chromium, and fumes, gases, and vapors of known toxicity[3]. A second field kit designed to estimate the amounts of such substances present is also described. This apparatus, depending on the selection of a suitable solvent, is adopted to practically any kind of work except the estimation of organic vapors. Such vapors usually constitute an explosive rather than an accident or health hazard and their estimation is carried out in a different manner.

The dust sampling and counting procedure of the United States Public Health Service is usually specified as the standard for this country and has in some instances been made obligatory by state authorities. Its application requires a considerable degree of skill and consists essentially of drawing a measured amount of air through a flask of water, or other suitable liquid, the screening of this liquid to remove particles over a specific size and the counting of the remaining particles in a microscopic cell of known volume. The air stream may be impelled either by an electric exhaust motor or an ejector actuated by compressed air. When an electric exhaust motor is used, the volume of air handled is measured by a mercury manometer which is calibrated before the apparatus leaves the laboratory.

The ejector is fitted with an orifice plate and the volume of air moved is indicated by a pressure gauge which is likewise calibrated.

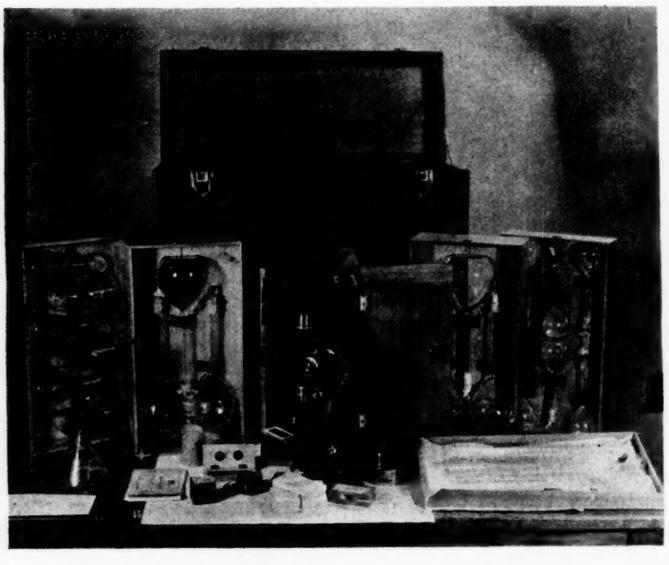
The collecting flask is fitted with a two-holed rubber stopper holding baffled outlet and inlet tubes. The latter has an impinger plate fastened in a position per-

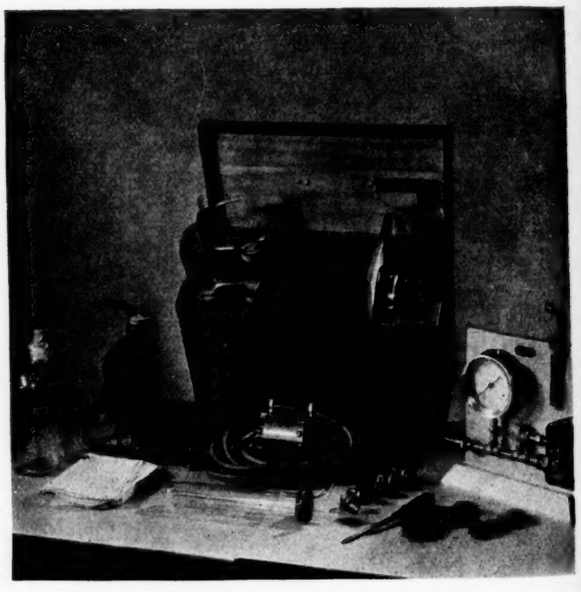
†All of the Chemical Engineering Unit, The Travelers Insurance Co., Hartford, Conn.

[1]Pneumonoconiosis. A review of; Pancoast and Pendergrass, Am. Jour. Roentgenology and Radium Therapy, October, 1931.

[2]Greenburg and Bloomfield, U. S. Public Health Report 47,654 (1932).

[3]General Orders on Dusts, Fumes, Vapors, and Gases, Industrial Commission of Wisconsin, Madison, Wis.





Figs. 1 and 2. Contents of the two kits used for sampling and counting

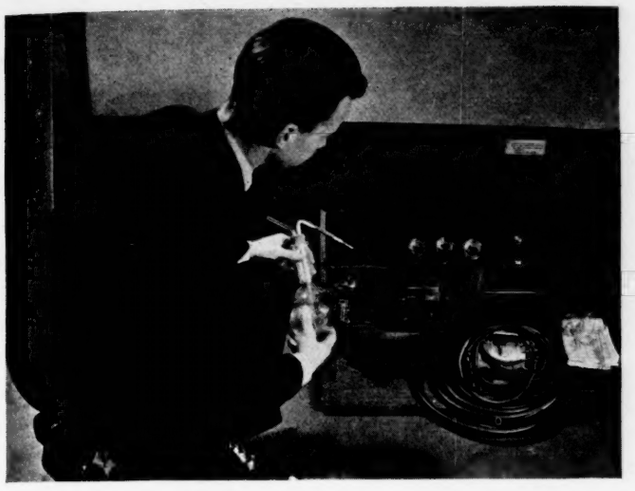


Fig. 3. Construction of kit for taking samples of air content other than dust

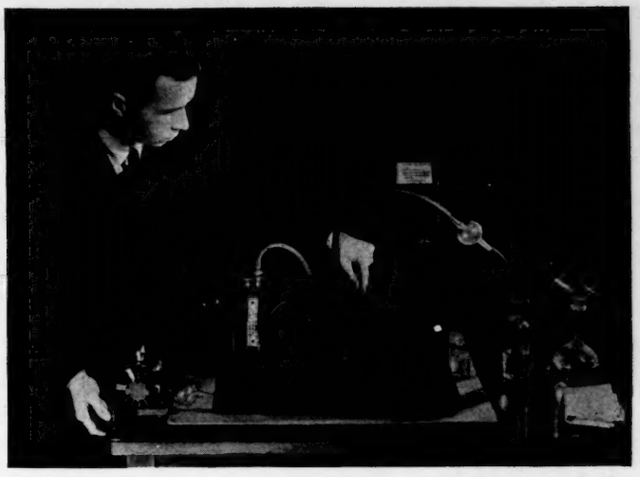


Fig. 4. Apparatus from kit shown in Fig. 3 connected in sequence for sampling

pendicular to the direction of the air stream and 5 mm. from the orifice, which is itself 2.3 mm. in diameter. The flask may be carried in a leather holster fitted with a shoulder strap to leave the operator's hands unhampered. The outlet tube is connected to the impelling apparatus by a suitable length of rubber hose allowing the operator a large area of movement without changing the position of the main apparatus.

The sample thus obtained is diluted to a definite volume, and a portion is superficially examined under the microscope to determine whether further dilution is necessary. When finally diluted, a portion of the sample is placed in a Sedgwick-Rafter microscopic cell whose depth is 1 mm. and the particles in a field 1 mm. square are counted under a microscope using a 7.5 eyepiece and a 16 mm. objective at 178 mm. tube length. A Whipple ocular micrometer disc is used to delineate the field for counting. From the average resulting particle counts of the contents of several 1 cu. mm. samples, the total dust content of the whole sample and 1 cu. ft. of the air tested may be calculated.

The foregoing is a meager outline of the procedure and describes none of the essential refinements of technique which are indispensable to accurate work. A United States Public Health bulletin[2] describes this technique in detail. The purpose of this brief description is only to indicate the use for the various apparatus hereafter mentioned. Provision is made for the taking of six successive samples before the counts are made and the apparatus cleaned. Following is a list of the apparatus carried in the kits:

1. Microscope in case, 7.5 eyepiece and 16 mm. objective.
2. Whipple ocular micrometer discs.
3. Six Sedgwick-Rafter cells.
4. Cover glasses for same.
5. Six, one millimeter pipettes.
6. Six, 10 ml. pipettes.
7. 350 mesh wire sieve.
8. Funnel to hold same.
9. Count recorder.
10. Several pieces white china silk cloth.
11. Lens paper.
12. 2 oz. bottle potassium dichromate crystals to making cleaning solution.
13. Six, 100 ml. volumetric flasks, glass stoppered.
14. Six, 500 ml. volumetric flasks, glass stoppered.
15. Six, 200 ml. Erlenmeyer flasks.
16. Wash bottle stopper and tubes to fit an Erlenmeyer flask.
17. Screw driver.
18. 2 doz. sheets filter paper 20 in. × 20 in.
19. Electric exhaust motor.
20. Mercury manometer.
21. Two ejector assemblies with vacuum or pressure gauges.
22. 40 ft. rubber tubing.
23. Six collecting flasks.
24. Six impinger tubes and exhaust tubes fitted in rubber stoppers.
25. Two leather holsters fitted with shoulder straps.
26. One, 6 in. and one, 10 in. Stillson wrenches.
27. Towels.
28. 1 gal. bottle distilled water.
29. Wooden feet for boards holding ejector assemblies.

Figs. 1 and 2 show the kits with contents unpacked. The kits are two in number, the smaller weighing, packed, about 30 lb. and the larger about 65 lb. The outside dimensions of the smaller are 25 in. × 17 in. × 9¾ in. and of the larger are 25 in. × 17 in. × 12 in. The kits are built of ½ in. mahogany and the inside trays and partitions are of mahogany and white wood. The size and weight of the kits make it easy for one man to transport them reasonable distances. The size and weight might be slightly reduced by dispensing with one of the ejector assemblies, but due to the fact that the kits are often operated at distant locations where replacement parts would be difficult to obtain, the second assembly is advised for the sake of security. When two operators work together, it is often possible to use both ejectors and/or the electric exhaust motor at the same time, thus effecting a considerable time saving. The kits may be made smaller by carrying less than six flasks of all the various sizes, but this requires counting each sample before taking another and is not suggested. The loss of time by such procedure is considerable.

The smaller of the two kits is shown in Fig. 1. Items 1-12 are packed in the microscopic case, wrapped in pieces of the china silk cloth which are afterwards used for polishing the cells, cover glasses, and the Whipple disc. The remainder of the kit is taken up by five trays which nest each above the other. Details of tray construction are shown in Fig. 5. Items 13-18 are carried in these trays. The various flasks are fitted into openings in the bottom of the trays and held rigidly in place by elastic straps. The shallow top tray carries only items 16, 17, and 18, with such other incidentals as may be necessary.

The larger of the two kits is shown in Fig. 2. It contains items 19-29. The ejector assemblies are permanently mounted on upright boards which fit into slots in the bottom of the case. When removed for use,

these boards fit into slotted wooden feet. One of these boards has the mercury manometer mounted on it. The impinger assemblies are wrapped in towels and placed each inside a flask. The flasks are in turn wrapped in towels and placed in the six compartments. The motor and exhaust pump is fastened to the bottom of the case beside the ejector, while the tubing is coiled above. Within the coils of the tubing is fitted the gallon bottle of distilled water. If distilled water is available near the job, this item may be omitted. In any case, an accurate control count is made on the distilled water used.

The material has been so divided between the two kits that the larger one contains the items used in actual sampling, while the smaller contains those used in diluting and counting. Thus, it is usually unnecessary to unpack the smaller kit in dusty atmospheres where samples are taken, but it may be set up in a dust-free location.

For shipping the kits from place to place a suitable packing case has been constructed. The kits fit side by side and are held away from the walls of the shipping case by compressed springs on all sides. This method of packing has made possible the shipping of the kit long distances without breakage or disturbance of the contents.

The apparatus for taking samples of air content other than dust was mentioned earlier in this article. In principle, it is much like the dust-sampling outfit, but is lighter and more compact. The air stream is actuated by an electric exhaust motor, drawing a definite volume of air through a bottle containing water or dilute acid. Consideration of the substance to be collected decides the nature of the solvent used. The air stream is impinged directly against the bottom of the collecting bottle from an orifice 2.3 mm. in diameter and set 5 mm. distance from the bottom. No baffle plate is provided before the outlet of the bottle, but a Kjeldahl bulb is used to prevent loss by splashing. The volume of air passed is calculated from readings on a mercury manometer which is calibrated periodically in the laboratory.

The kit complete with contents weighs approximately 35 lb. Six bottles are provided for taking a like number of samples. It is considered best practice to bring all samples back to the laboratory for chemical analysis.

Fig. 3 shows the construction of the kit and the contents usually carried in it. Fig. 4 displays the apparatus connected in sequence for sampling. The hand of the operator is upon the bleed valve which controls the air flow. The length of tubing to either sampling bottle or exhaust motor may be varied when the scale on the manometer is properly calibrated for use of different lengths. The following is a list of apparatus carried in the kit.

1. Manometer filled with mercury to zero mark.
2. Two impinger units (each consisting of a two-hole No. 8 rubber stopper, one impinger tube, and one exist tube).
3. Glass rod with bend ¼ in. from end and of 5 mm. thickness for spacing end of impinger tube and bottom of bottle.
4. 100 ml. graduated cylinder.
5. Electric exhaust motor with extension cord.
6. Six, 300 ml. wide mouth glass stoppered bottles.
7. 1500 ml. bott'e for distilled water or special solutions.
8. Complete iron stand and clamp (base, short rod, clamp holder, and clamp).
9. Vial of mercury.
10. Glass cross for manifold and spare.
11. Glass "T" for manifold and spare.
12. Connection for rubber tube to exhaust motor.
13. ⅜ in. heavy rubber tubing for connections.
14. 2 Kjeldahl bulbs.
15. Small wash bottle.
16. Towels.
17. Tags and gummed labels.
18. Celluloid solution for sealing bottles.
19. Lubricating oil for motor.

The manometer, in the glass cross, and glass tee are fastened to a panel in the front of the kit. The glass cross and tee are connected as shown in the photographs to form a manifold of five openings. One opening leads to the manometer, one to the sample bottle exit, one to the exhaust motor, while the fourth is a bleeder to control the air flow. The fifth opening at the bottom of the cross is fitted with a rubber stopper and is used only if drainage is necessary.

The rate of air flow used is 1 c.f.m. The glass rod (Item 3 in list of apparatus) is so designed that it may be passed into the bottle through the exit opening and used to space the height of the impinger nozzle at 5 mm. from the bottom of the bottle. The spacing may also be accomplished by a scratch mark on the side of the bottle at the proper height.

This apparatus is occasionally used for collecting dust samples as well as for fumes and gases. The only essential difference in construction from the dust-sampling unit is the unfixed position of the impinger nozzle in relation to the bottom of the bottle. Investigation[4] of the differences in results brought about by reasonable variations in the distance of the impinger from the plate and in the angle of deviation from the perpendicular has shown that results are not seriously altered. Since this kit carries no apparatus for diluting and counting dust samples, it is used only when it is practical to bring the kit and samples back to the laboratory for this part of the work.

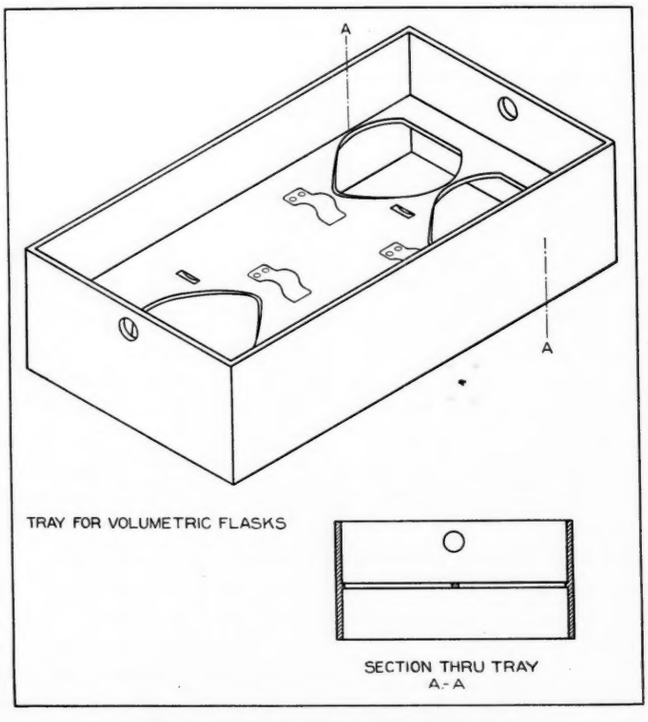


Fig. 5. Details of tray construction

[4]Hatch, Warren, and Drinker, Journal of Industrial Hygiene, 14,301 (1932).

EDITORIALS

An Opportunity

NOW that codes of fair practice are being drawn up there is an opportunity to write into them definitions of what constitutes air conditioning apparatus. Initial moves have been made and proposals have met with the approval of some of the interested parties. It remains to be seen whether the proposals will carry through. We have repeatedly called attention to the confusion caused by the present situation which results almost altogether from advertising copy which is not consistent in using the words. Agreement on definitions and their incorporation into a fair practice code would go a long way toward correcting the difficulty.

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Is CO_2 to Go?

ONE of the interesting recent A.S.H.V.E. papers reports that it appears that another index of air distribution besides the time-honored one of carbon dioxide content may be worth considering. The suggestion is made that the change in moisture content may serve as a suitable index. Data presented with the paper bear out the validity of the suggestion. Such a method of measurement would substitute the use of a psychrometer for the use of a carbon dioxide apparatus. Anyone who has used both pieces of apparatus will agree that of the two the psychrometer is easier to handle. A move away from the old CO_2 method will be welcome.

●

Code-Drawing

CODES and code-making are the order of the day. With the opportunity offered by the Recovery Act, and with the number of interested groups eligible to submit codes, the past 30 days has been a period of code-drawing such as was never seen before. These codes represent the first concrete evidence of the much deeper changes in business contemplated by the act. Only a few have actually been released, but from known activities it seems apparent that practically every organized trade group will offer or participate in a code.

The situation in our own industry is that there is certain to be a variety of codes drawn, for many are in course of preparation. It is evident that there is still confusion regarding just what is expected, the limits of action permitted, and the exact attitude at Washington. How many of the codes now being prepared will ever be filed and made effective is still problematical, for it is reported that the administration would like to see small groups join with larger grougs in order to reduce the total number of codes. In the meantime, however, code preparation proceeds at a merry pace with plenty of conferences and meetings.

Soon will come the stage when all these codes will have to pass public and official inspection. Judging by what has already happened, it is at these public appearances that the real troubles and vexations will arise. Even now it is evident that there is a sharp cleavage of ideas between management and labor, and by the time the distribution groups are reached it is probable that there will be still further cleavages between producers and distributors. The job of listening to these differences and composing them is sure to be trying. How successful it will be is a problem. One thing seems sure, though—and that is that a public airing of the differences of opinion will be good for the souls of all concerned.

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Cast-Iron Convectors

INTERESTING new forms of heating surface made from cast iron have put in an appearance. For some time it has been easy to see that artistic, ornamental, and effective surfaces which would lend themselves to concealed, wall, or flush mounting could be made from cast iron, but whether they would actually be available to the trade at prices within reason and able to compete was a question which could not be predicted. Now they are here. Development and production of these styles and patterns put cast iron into a better competitive position than it has occupied for some time past.

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Engineers' Week

ENGINEERS' Week at the Chicago Fair was advertised as the greatest gathering of engineers ever held. In that respect it certainly lived up to its advance notices. Engineers were everywhere. They overran and taxed the capacities of the Loop hotels to the utmost. They even made a respectable start toward filling the huge stadium on the occasion of the Guggenheim award. Aside from this feature of a large crowd it is questionable whether the idea of bringing so many engineering bodies into one city for simultaneous meetings is worth repeating. With the Fair as a side attraction there was little of the usual opporunity to meet and talk with friends and acquaintances—one of the really worthwhile features of most meetings.

Abstracts . . .

Reviews and Summaries of . . . Current Papers, Books and Pamphlets

Ventilation and Visual Fatigue

According to a booklet edited by Aaron E. Singer, ventilation as well as illumination and seating are causes of visual fatigue on the part of motion picture audiences. The booklet itself is brief and deals with advances made in reducing visual fatigue. Brief summaries of reports also give the views of many workers in this field.

[*Title: "The Visual Fatigue of Motion Pictures," by Aaron E. Singer; a paper-covered pamphlet; 48 pages; 5 in. × 7¼ in. Published by Amusement Age Publishing Co., New York; price, $1.*]

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Bailey's Handbook for Operating Engineers

A feature of the sixth edition of Bailey's Handbook for stationary engineers is the addition of a section of questions and answers on heating, ventilating, and air conditioning. The new section follows the general plan of the older parts in that the material is that which is informative to operating men. Questions are those such as are commonly asked in licensing examinations. In general they are fairly free of technical detail and are simple and direct. Addition of this section should inincrease the usefulness of the book to those who are preparing for operating license tests. Other sections deal with traps, steam engines and boilers, and mechanical refrigeration plants.

[*Title: "Bailey's Handbook for Stationary, Marine, and Diesel Engineers." Published by Goodheart-Wilcox Company; 4¾ in. × 6½ in.; fabricoid; 263 pages; price, $2.*]

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A Popular and Comprehensive Book on Smoke

Under the title, "Stop That Smoke!", Henry Obermeyer, of the gas company which supplies New York, has written a book which in popular style takes up the subject of smoke prevention and abatement. During the course of the book he cites virtually all the published material. This in itself is no innovation but popular treatment of the subject by a writer well qualified for the task is distinctly new. As an instance of the broad viewpoint used, consider the following sentence from the introduction. "The slow poisons, rather than occasional floods and explosions, are the real destroyers of generations and even civilizations, once the public sense of danger and indignation has been dulled . . . . . We take the air as it comes—defilement, pollution, and all. No paternal government sets up standards of purity for free oxygen, although such standards have been applied to scores of commodities far less vital to our lives, liberty, and happiness." This sounds much like the arguments so often voiced and so well known by everyone interested in heating, ventilating, and air conditioning. The difference is that it is expressed in broader terms. Much the same may be said of the book as a whole.

[*Title: "Stop That Smoke!" by Henry Obermeyer. Clothbound book of 270 pages; 5½ in. × 8½ in.; unillustrated. Published by Harper & Brothers; price, $2.50.*]

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Testing Convectors Under Warm Wall Conditions

A problem which is involved in radiator testing is that of keeping a specified temperature in the testing enclosure with a close tolerance. A convenient way to overcome the operating difficulty arising from this is to allow a relatively large tolerance in the temperature and to compute the results to a given specified temperature. For some time it has been known that such computations can be made by the Dietz equation using the 1.3 power of the ratio of the differences between the specified temperatures of steam and air and the difference actually existing during tests. The test codes of the A.S.H.V.E. have permitted the use of this factor for correction purposes, but there was doubt as to how wide a tolerance was really permissible when heaters of the convection type were used. A recent paper reports the results of studies made to clear up the doubtful point.

Convectors were set up in a warm wall booth and enough sizes and styles were used to learn their effects as well as to examine the limits within which the factor is usable. It was found that in all cases studied the maximum variation between results found by test and those computed by applying the factor was not greater than 5% so long as the testing temperature was kept between 60° and 80°. Moreover, the greater deviations occurred at the high temperature. As a result it would seem that the deviations at 60° are negligible while those at 80° are great enough so that the authors feel that the range of permissible test temperatures might well be reduced to from 60° to 75° instead of continuing to use the range 60-80 as the older codes permitted. It is interesting to note that this suggestion has been incorporated into a newly printed code of the society which lays down a standard procedure for rating and testing concealed gravity-type radiators.

[*Title: "Tests of Convectors in a Warm Wall Testing Booth," by A. P. Kratz, M. K. Fahnestock, and E. L. Broderick; A.S.H.V.E. paper presented at semi-annual meeting June, 1933; approximately 2000 words; 7 figures and 1 table.*]

News of the Month

Concealed Heater Manufacturers Association Formed

A meeting of concealed heater manufacturers was held on June 23 at the Hotel Statler, Detroit. It was voted to form an association to be known as the Concealed Heater Manufacturers Association, for the purpose of executing the provisions of the National Industrial Recovery Act, effecting standardization and simplification of terminology, testing and rating methods, etc.

Those in attendance were representatives of the following companies, who constitute the original members of the Association: American Radiator Company; Chase Brass & Copper Company; Commodore Heaters Corporation; C. A. Dunham Company; Hart, Cooley, Highton Company; Heintz Manufacturing Company; Revere Copper and Brass, Incorporated; The Trane Company; Warren Webster & Company; Wolverine Tube Company, and Young Radiator Company.

Reuben N. Trane, president of Trane Co., La Crosse, Wis., was elected president of the new association, and Maurice G. Steele, sales manager of Rome Radiation Co., Division of Revere Copper and Brass, Inc., was elected secretary-treasurer.

N. D. H. A. Men Hold Busy Four-Day Convention

The 24th annual convention of the National District Heating Association took place in Chicago, June 27-30, with headquarters at the Palmer House. About 100 were in attendance. The Tuesday morning session started off with an address of welcome by John F. Gilchrist, president, Illinois Maintenance Company, to which D. L. Gaskill, secretary-treasurer of the Association responded. This was followed by an address by E. E. Dubry, president of the Association, after which the preliminary routine business of the meeting was disposed of. Reports of the secretary-treasurer, the Educational Committee, and the Committee on Rates and Regulations were heard, and a Nominating Committee was appointed.

J. F. Collins, Jr., opened the afternoon session with the report of the Distribution Committee, under which the following topics were taken up: Comparison of Design Methods; Comparison of Construction Methods; Line Losses and Delivery of Super-heated Steam; Heating Effect of Underground Steam Lines; Distribution Line Loss and Unaccounted for Steam, and Comparison of Operating and Maintenance Methods for Distribution Systems.

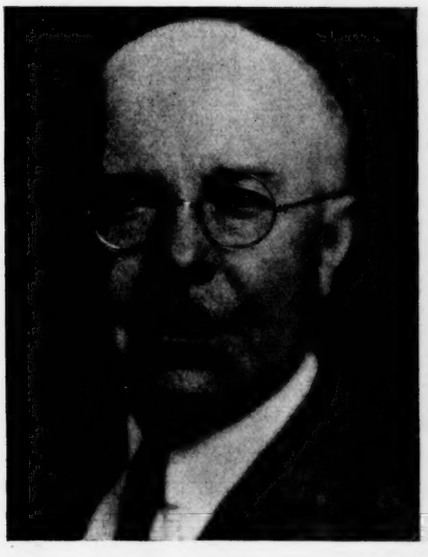
Arthur J. Slade then spoke on "District Heating Distribution System Construction in Washington, D. C." The report of the Meter Committee, read by E. A. Lueky, and the Manufacturers' Round Table discussion, completed the activities of the day.

At the Wednesday morning breakfast meeting J. E. Hillemeyer presided over a discussion of "Rates and Regulations," and the topic "Meters" was taken up under the leadership of E. A. Lueky.

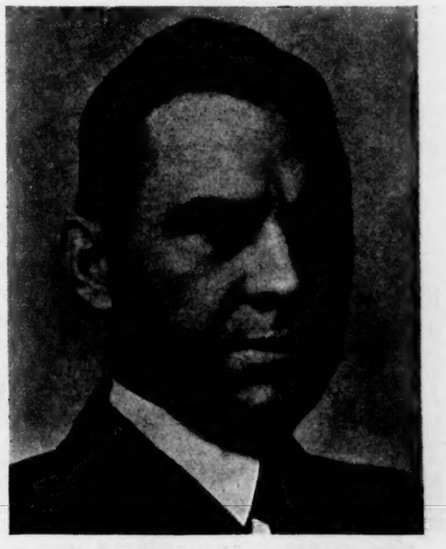
Considerable discussion attended the presentation of the report of the Research Committee, by G. K. Saurwein, which was the opening event on the morning session program. The report of the Sub-Committee on Corrosion was then read and discussed. The following subjects were considered under the report of the Station Engineering Committee, presented by H. J. Bauer, chairman: "Bituminous Coal Freight Rates Must Be Reduced," by Charles O'Neill; "Principles of Gas Washing Applied to Sulphur Dioxide Removal," by H. F. Johnstone; "Determining Factors in Feedwater Treatment for Plants Using Large Quantities of Makeup," by Sheppard T. Powell; "Recent Developments in Fuel-Burning Equipment," by J. R. McCausland; "The Utilization of Competitive Fuels," George Orrok,

NEW N.D.H.A. OFFICERS

J. E. Hillemeyer, president



W. J. Baldwin, Jr., 1st vice-president



R. L. Fitzgerald, 2nd vice-president

Jr., and "Comparative Study of By-Product Generating Cycles," by R. G. Felger and M. W. Benjamin.

The Distribution Committee, with J. F. Collins, Jr., presiding, and the Steam Station Engineering Committee, H. J. Bauer presiding, met for discussion Thursday morning at breakfast. The morning session opened with a report of the Sales Development Committee, J. E. Seiter, chairman. Reports of the Commercial Relations Committee, R. L. Fitzgerald, chairman, and the Insurance Rates Committee, S. S. Sanford, chairman, were then heard.

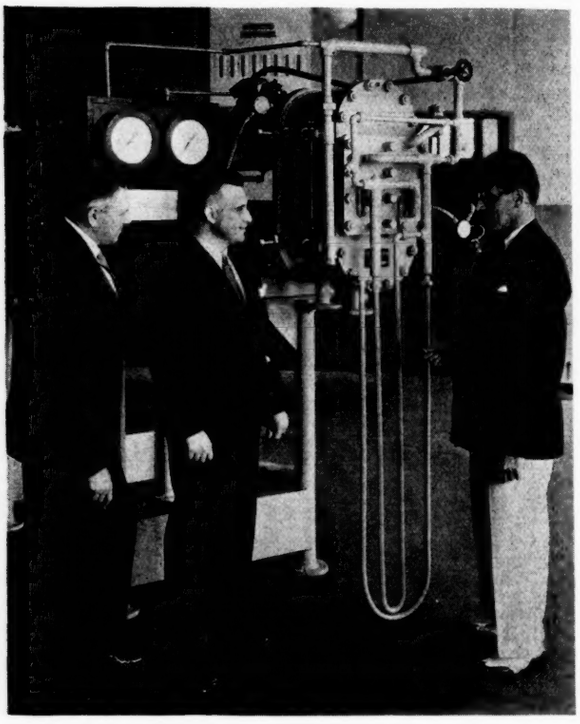
At breakfast Friday morning, the Sales Development Committee, J. E. Seiter presiding, and the Commercial Relations Committee, R. L. Fitzgerald presiding, met for discussion. Election of officers was the first business to come before the convention at the Friday morning session. J. E. Hillemeyer was elected to succeed Mr. Dubry as president for the coming year. The report of the Operating Statistics Committee was then heard, followed by the report of the Hot Water Committee, and a progress report of the Pure Air Committee.

The convention adjourned after the installation of the new officers.

New Code Proposed and Tests Reported at A. S. H. V. E. Summer Meeting

About 250 members and guests of the A.S.H.V.E. gathered at the Statler Hotel, Detroit, June 22-24, for the Society's semi-annual meeting. Three lively technical sessions, important business transactions, and a carefully-planned schedule of social events, provided a profitable an enjoyable three-day program.

The opening session got under way immediately following brief words of greeting and welcome by L. L. McConachie, president of the Michigan Chapter, and D. L. Taze, president of the Western Michigan Chapter, to which President W. T. Jones responded in behalf of the Society. First to be read was "Temperature Gradient Observations in a Large Heated Space," by D. W. Nelson, O. C. Cromer, and G. L. Larson, who read the paper.



Decalorator steam jet refrigerating unit on display in the shops of the American Blower Corp., Detroit, Mich. Walter Fleisher, right, consulting engineer, New York, inspects the unit with H. E. Barth, center, sales manager, and Arthur Ritter, left, manager of the New York Branch, American Blower Corporation.

F. C. Houghten, director of the Society's research laboratory at Pittsburgh, then read "Indices of Air Change and Air Distribution," by himself and J. L. Blackshaw, research engineer at the laboratory. This reports the results of investigations conducted at the laboratory into the various methods oof measuring air change and distribution in a ventilated space.

Changes in the physical and chemical composition of the air in an enclosed space involving moisture, latent heat, sensible heat, and CO_2 content brought about by human occupation, were investigated, and the authors conclude that greater consistency was obtained by determinations made from the moisture content method than by the CO_2 observations. A simple psychrometer determination of the moisture content is therefore recommended as an index of air change, superior to analysis for CO_2 in ease of determination and in reliability.

Followed a report of the Committee on Atmospheric Dust and Air Cleaning Devices, by H. C. Murphy, chairman, in which a code standardizing the methods for testing these appliances is proposed and submitted. The code specifies the conditions under which the tests shall be conducted, and would require that the following information be supplied by the test results: reconditioning time in hours; capacity, in cubic feet per minute per square feet of face area; per cent of average arrestance; resistance to air flow in inches of water, at 50% of the operating time cycle, and power required for reconditioning the air cleaner, expressed in watts whatever method is used. The code was accepted as submitted by the membership present, and recommendation was made to the Council that it be submitted to a mail vote of the membership.

With the exception of a meeting of the Membership and Chapter Relations Committees, the afternoon was devoted to entertainment, a motor trip and luncheon for the women guests, and a golf tournament at the Meadowbrook Country Club for the men. A buffet supper with dancing at the club in the evening concluded the activities of the day.

Friday morning, June 23, opened with meetings of the Nominating Committee and the Committee on Ventilation Standards. L. A. Cherry opened the technical session with a paper describing his circular slide rule for determining the sizes of pipes and restricting orifices for hot water heating systems. The calculator is based on data supplied by Prof. F. E. Giesecke from his researches on hot water plants. The device is so arranged that with a known load, expressed either in heat

transfer rate or radiating surface, the total friction of pipe, fittings, and orifices can be read for any given temperature drop in the radiators.

Next, Prof. A. P. Kratz read a paper, "Application of the Eupatheoscope for Measuring the Performance of Direct Radiators and Convectors in Terms of Equivalent Temperature," in which he had collaborated with Prof. A. C. Willard and Prof. M. K. Fahnestock. The eupatheoscope is an instrument which determines the combined effects of convection and radiation in determining the feeling of warmth or cold experienced by an individual subjected to a given set of conditions. The instrument consists essentially of a hollow copper cylinder painted black, which can be maintained at some constant temperature so that radiation losses can be determined. Important conclusions reached by the authors are: as a provisional standard of comfort conforming to American practice, a room may be assumed to be comfortably heated when a sizable body at 83° loses heat at the rate of 15.4 B.t.u. per sq. ft. per hr.; the readings of the eupatheoscope serve as a means of ranking various heating units in the order of the relative heating effects produced; the total heating effect is not appreciably greater than the heat output as measured by steam condensation under given standard conditions, and the practice of adding a large proportion to the condensation rating in order to compensate for heating effect cannot be justified; the proximity of cold walls has an appreciable effect on the degree of comfort as determined by the eupatheoscope.

"Tests of Convectors in a Warm Wall Testing Booth—Part II," was then presented by Professor Kratz. This was a report of a research conducted by himself in association with M. K. Fahnestock and E. L. Broderick, research assistant in mechanical engineering, University of Illinois, and is reported in detail in the "Abstracts" section of this issue of HEATING AND VENTILATING, page 40.

The concluding business of this session was a report of the Committee on the Code for Testing and Rating Convection Heaters — Hot Water Section—by R. N. Trane, chairman. The proposed code was accepted by the membership present and referred to the Council with recommendation that it be submitted to a general mail vote of the society.

The Committee on Nomenclature, S. R. Lewis, chairman, met in the early afternoon to discuss the adoption of a new unit of radiating surface output capacity. The committee's recommendation, that the symbol Mb., signifying 1000 B.t.u., and Mbh meaning 1000 B.t.u. per hr., be used in place of the customary "square feet of radiation," was ratified at a later session.

The afternoon was devoted to golf, inspection trips, and a visit to the Detroit Art Institute. The semi-annual banquet and dance was held at the Grosse Pointe Yacht Club in the evening, at which time, through the good offices of Dean F. P. Anderson, University of Kentucky, W. H. Driscoll, W. T. Jones, L. A. Harding, and S. L. Lewis, became, with due ceremony members of the "Kentucky Colonels."

The final session opened on Saturday morning with "The Heat Conductivity of Wood at Climatic Temperature Differences," a paper by Prof. Frank B. Rowley, University of Minnesota. This was a report of a series of investigations into the influence of moisture content and density on the thermal conductivity of the various species of wood used commercially.

"Physiological Changes During Exposure to Ionized Air," by C. P. Yaglou, A. D. Brandt, and L. C. Benjamin, was then read by Professor Yaglou. This records the observations made upon human subjects at rest in an ionized atmosphere. A group of 60 persons, in a total of 141 experiments, were exposed for a period of 1 hr. or more to air containing from 5000 to 1,500,000 ions per cubic centimeter. Under the experimental conditions ionized air appeared to exert a normalizing influence on the subjects by accelerating the physiological processes, where they were below normal, and decreasing physiological activity where the processes were above the normal range. Following the exposure, there was a reversion of the functions toward their steady state prior to the ionization period. Positive ionization tended to cause headaches and irritation of the nose and throat, whereas negative ionization predisposed to relaxation and other sensations of a desirable character.

Prof. L. E. Davies, Armour Institute, Chicago, then discussed "Measurement of Air Flow through Registers and Grilles." This is a report of Professor Davies' investigations into the methods of accurately determining in the field the flow of air through ornamental and irregularly-shaped ventilating outlets.

F. C. Houghten read the concluding paper of the meeting, "Carbon Monoxide Distribution in Relation to the Heating and Ventilation of a One-Floor Garage," by himself and Paul McDermott. The authors concluded that a lower rate of air change and a smaller heating load are required with upward than with downward ventilation, and that upward ventilation results in more uniform temperatures. CO concentration is generally less with upward ventilation than is obtained with complete mixing of exhaust gases and supply air. An air change of 350,000 cu. ft. per hr. per idling car in the garage, was found to be required to keep the CO concentration down to one part in 10,000.

Luncheon and an inspection of the American Blower Corporation's air conditioning exhibit completed the activities of the meeting.

Mechanical Equipment on Display at Midwest Power Show

A number of new developments in the engineering field were on display June 27-29 at the Sixth Midwest Engineering & Power Exposition, Hotel Stevens, Chicago. Ninety firms exhibited, including a number of manufacturers of heating, ventilating, and air conditioning appliances. Among the interesting highlights were a line of oil burner fuel pumps, capacities to 100 g.p.m. at

250-lb. pressure, which can be direct connected to a 1200-r.p.m. motor; a series of propeller-type fans for ventilation and forced-draft, in two and four-blade models with tapered blades drop-forged from aluminum alloy; a hydraulic-type testing device for pressure gauges, utilizing a springless scale dial; improved composition packing cups; a testing device for belt slippage, and a complete internal combustion engine weighing 8 oz.

Among those maintaining display booths were; Ames Pump Co., New York; Armstrong Machine Works, Three Rivers, Mich.; E. B. Badger & Sons, Boston; Barber-Colman Co., Rockford, Ill.; Chicago Belting Co., Chicago; Coppus Engineering Corp., Worcester, Mass.; Fulton-Sylphon Co., Knoxville, Tenn.; Graton & Knight Co., Chicago; The Hays Corp., Michigan City, Ind.; Kay & MacDonald, Inc., West Orange, N. J.; Wm. Powell Co., Inc., Cincinnati; Powers Regulator Co., Chicago; Sarco Co., Inc., New York, and The C. E. Squires Co., Cleveland.

Heating Contractors Adopt New Name, Code at Convention

Change of name of the H. & P.C.N.A. to the Heating, Piping and Air Conditioning Contractors National Association, Inc., was voted at the 44th annual convention, held in Chicago, July 25-28, at the Sherman Hotel. An attendance of over 200 was registered. Many technical and merchandising problems were discussed, and a code, in line with the NIRA was submitted and adopted.

Addresses of welcome by John W. Gorby, representing the city of Chicago, and R. D. Berry, president of the Chicago Association, initiated the activities of the opening session. President Robert D. Williams, New York, spoke of the problems of the year just passed, and expressed a hope that the work of the association has exercised a constructive and stabilizing influence during the stress of the times. Mr. Williams called the NIRA the "most important event that has occurred to business men during the last year," and urged cooperation.

The treasurer's report revealed that the total income between June, 1932 and June, 1933 was slightly in excess of $35,000, with operating costs of $30,800. Secretary Fitts then presented his report, in which the status of the industry was outlined, and discussed with relation to the NIRA.

Stanley Jenks brought the greetings of the American Gas Association, and E. N. Craig, former secretary of the Chicago Master Steamfitters Association, and F. W. Herendeen, of the Boiler and Radiator Institute, were recognized and spoke briefly.

Speaking on "The Outlook for Business under the National Industrial Recovery Act," Prof. William Homer Spencer, Dean of the School of Business, University of Chicago, reviewed the causes of the present economic condition, and pointed out why an industrial recovery act is necessary. He stressed the importance of trade associations cooperating with the administration to bring the work to a successful conclusion.

Membership Committee's report revealed that 50 new members were enrolled during the past year. R. L. Spitzley followed with the report of the Committee on Separation of Contracts. Progress on the bill which aims to bring about reforms in federal government contract work has been temporarily halted due to the pressure of emergency legislation on Congress, according to Mr. Spitzley, who stated that the committee will continue its endeavors to bring about enactment.

This concluded the business of the first day, and the evening was devoted to "Hollywood at the Fair," where the delegates and their guests dined and enjoyed entertainmnt features.

A report of the Committee on Standards, by George P. Nachman, chairman, opened the Wednesday morning session. The work of the committee has been a continuance largely of the studies of the problems of hot water heating begun several years ago. Data and information on air conditioning have also been tabulated and will be released in the near future.

"Air Conditioning for Heating Contractors" was next presented by Samuel R. Lewis, consulting engineer, Chicago. Mr. Lewis described a system which he stated would answer the requirements for all multi-story buildings most admirably. This system, said the speaker, would use force-circulated hot water as the heat transfer medium, using conventional radiators or convectors in all outlying rooms, and fan-equipped convectors with provision for humidification and air cleaning in the principal rooms. Where necessary, provision for cooling and dehumidification is made in connection with the forced convectors. Mr. Lewis advocates a system operating on a similar principle for the ideal residential air conditioning installation.

This was followed by a brief address by John Howatt who extended the greetings of the A.S.H.V.E. J. Lawrence DeNeille read the report of the Committee on Air Conditioning.

The report of the Committee on Welding was next given by J. H. Zink, chairman. John Usher presented a paper, "Multiple Refrigeration—Installation and Operation," in which he pointed out that heating and refrigeration are virtually similar processes, and emphasized the fact that the contractor's experience with heating devices qualified him to enter the domestic refrigeration and air-cooling market in its fullest scope.

The remainder of the paper was devoted to a discussion of refrigeration, in which a comparison is drawn between a multiple installation and an individual installation of similar capacity.

Harry M. Hart read the report of the Sub-Committee on Boiler Output, which concluded the business of the second day. The annual dinner dance took place at the Sherman Hotel on Wednesday evening.

The Thursday morning session was devoted to a discussion of the proposed code formulated in accordance with the NIRA. Benjamin S. Kirsh introduced the subject with an address, "The Legal Aspect of Operation under the National Industrial Recovery Act," in which he pointed out the problems incident to establishing standards of fair trade practice. After discussion the code was accepted by the convention and referred to the Resolutions Committee for revision and submission to the Administration. Important provisions of the code will be found on page 50 of this issue.

Russell G. Creviston, Crane Co., Chicago, followed with a talk on boiler-burner units, pointing out the merchandising possibilities offered the contractor by this equipment. H. B. Johns then spoke on the merchandising of conversion burners.

A talk by Homer J. Buckley, "Will the Business Upturn Help You Sell More Heating?" in which the contractor was warned to change his sales procedure to bring it in line with the new industrial order, completed the scheduled events of the third convention day.

The first business on Friday morning was a report on the Committee of Ten—Coal and Heating Industries, by Harry M. Hart. The committee finds that much work is to come from repair and maintenance, and recommends that contractors cooperate with retail coal dealers in developing this market.

The report of the Committee on Certified Heating as prepared by C. P. Finke, was then read by Doctor Land. This committee recommends that the committee be charged with the responsibility of developing a program for the certification of air conditioning and multiple refrigeration installations.

Robert D. Williams was reelected to the presidency of the association, as were J. Lawrence DeNeille, vice-president; John H. Zink, treasurer, and Joseph C. Fitts, secretary. M. J. Chagnard, John H. Zink, George A. Dickerson, and E. W. Tomkins, were named directors for the coming year. Adjournment followed the report of the Resolutions Committee.

McIlvaine Appoints Dealers

McIlvaine Burner Corp., 663 West Washington Blvd., Chicago, recently appointed the following dealers: Erickson Plumbing & Heating Co., 514-13th St., Moline, Ill., and Automatic Heating Sales Co., 223 West Dutton St., Kalamazoo, Mich.

Manufactured Gas Volume for House-Heating Down

Figures supplied by the Statistical Department of the American Gas Association indicate a decline of 1.1% in the use of manufactured gas for house-heating in the United States during May, 1933, as compared with the same month a year ago. Use of manufactured gas for this purpose fell off 2.6% during the five months ending May 31 from the house-heating volume for the same period last year. This was in spite of a marked increase in general heating load as indicated by a greater number of degree-days recorded for the season just past.

News of the Month

Refrigeration Men Hold Convention in Chicago During Engineering Week

With approximately 275 in attendance, the 20th Western Meeting of the American Society of Refrigerating Engineers opened at the Hotel Sherman, Chicago, June 26. Business meetings, social events, and three technical sessions, the second of which was devoted exclusively to air conditioning subjects, constituted three busy days.

Monday morning, June 26, was devoted to registration and a meeting of the Council. Following the welcome luncheon, at which Col. E. W. Wentworth was the speaker, the first technical session opened with Alfred W. Oakley, president of the society, in the chair. The topic was "Current Problems," and the first to be discussed was "The Evolution of Condenser Design," a paper presented by Herbert C. Guild, A. M. Byers, Inc., Pittsburgh. This was followed by a paper, "Natural Gas Engines in the Ice Plant," by C. Thomas Baker, consulting engineer, Atlanta, Ga. Mr. Baker gave figures and data on

York Oil Burner A. C. national champion weight-lifting team, members of which hold 12 of the 15 national records. Standing — Harry Good, George Jowett, Joe Miller, Harry Schaeffer, Al Robinson, Ben Markley, Bill Good, Henry Wertz, James Messer and Wally Zagurski. Seated — Bill Lilly, Dick Bachtel, Art Levan, Bob Mitchell and Tony Terlazzo. Zagurski, Bill Good, Bachtel and Terlazzo were members of the American Olympic weight-lifting team last year. All are employed by York Oil Burner Co., Inc., York, Pa.

three ice plants which have realized important savings through the installation of natural gas engines for compressor and auxiliary power drives.

Gene Edwards, graduate student, University of Illinois, next read "Fluid—Pressure Loss due to Flow of one Fluid as a Criterion of Loss of any Fluid," prepared by himself and H. J. Macintire, professor of refrigeration at the university. They found that the general equation of fluid flow may be justifiably used in determining the pressure losses for any fluid in a pipe, provided that the experimental constant k and the exponent of the velocity are known. They further conclude that the practice of assuming that the velocity varies as the square instead of using the actual exponent in calculating the friction factor is misleading.

"A Modern System of Beer Production," by Dr. L. Nathan, Zurich, Switzerland, was read as the concluding paper of the session by Dr. J. C. Goosmann, New York. Doctor Nathan's process cuts the time required for the brewing of beer, and makes extensive use of refrigeration in controlling fermentation.

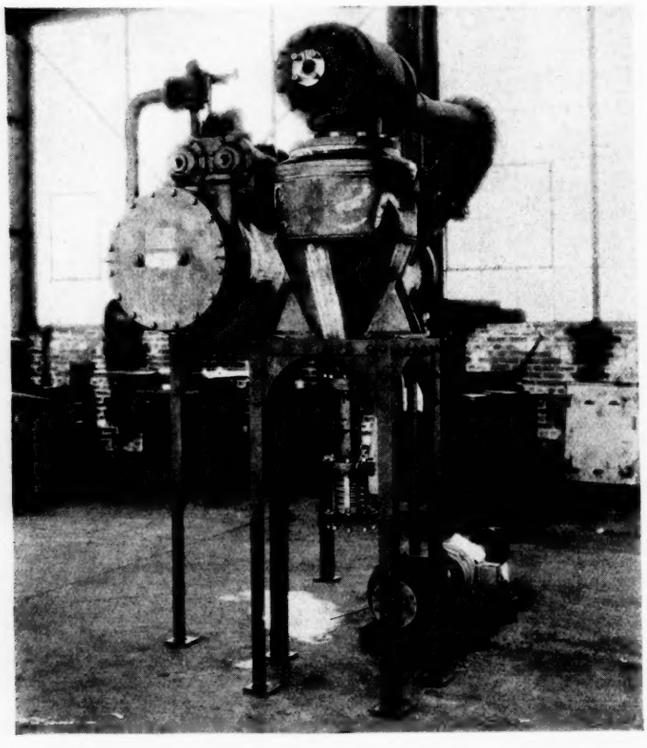
The Tuesday morning session, presided over by Glenn Muffly, past president of the society, took up the topic of air conditioning. A paper, "The Residence Cooling Problem—Aspects as Developed by Tests in the Research Residence," by A. C. Willard, department head, and A. P. Kratz, professor, School of Mechanical Engineering, University of Illinois, was read by Professor Macintire.

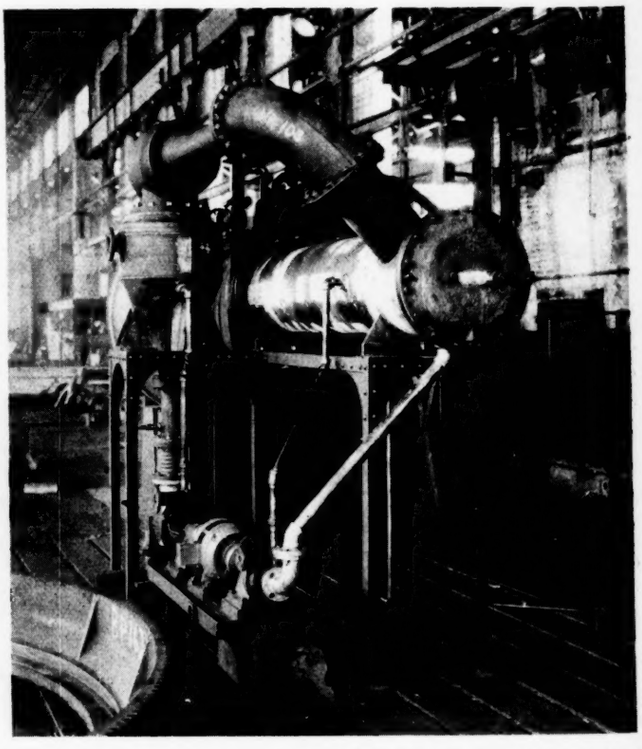
Followed "Self Contained Room Coolers," by C. R. Neeson, chief engineer, De La Vergne Refrigeration Division, Baldwin-Southwark Corp., Philadelphia, in which the construction and operation of the newly-developed cabinet-type room cooler, embodying reversed refrigeration for warming, was outlined.

Prof. W. R. Woolrich, University of Tennessee, Knoxville, then read "Unit Coolers—Effect of Humidity on Heat Transfer above and below the Freezing Point," in the preparation of which he had collaborated with P. W. Scates, and Mack Tucker, graduate students at the university. This reports a series of experiments demonstrating qualitatively the relationship between latent heat, sensible heat, and total heat with various combinations of coil temperature, air temperature, and relative humidity.

The air conditioning session was concluded with the reading by F. J. Hamilton of "Aerodynamics of Air Conditioning," by S. M. Anderson, B. F. Sturtevant Co., Boston.

Tuesday afternoon was given over to a discussion of the thermal problems of the refrigeration industry with Vice-president A. R. Stevenson, Jr., in the chair. Dr. R. M. Buffington presented his paper, "Absorption Refrigeration with Solid Absorbents," a discussion of the possibilities of a refrigerating system using strontium chloride which has the property of absorbing ammonia when cold, and of giving off ammonia when heated. The system is intermittent in its operation, the same apparatus serving as both generator and absorber. This was followed by "Thermodynamics of the Sulfur-Dioxide Refrigerating System in the Presence of Lubricants," by Dr. L. A. Philipp, director, and B. E. Tiffany, of the research laboratories of the Kelvinator Corp., Detroit.





Two views of a 30-ton steam jet refrigerator set up in the shops of the manufacturer, Foster Wheeler Corporation, before shipment to Philadelphia where it will be installed as a part of the air conditioning system of the Benjamin Franklin Institute. In the center of the view at the left is the flash chamber with the steam jet compressor directly above it. The surface condenser with a two-stage steam jet air pump mounted above it is seen to the left of the unit. The air conditioning system, installed by York Ice Machinery Corporation, also includes a 20-ton vacuum refrigerating unit.

Dr. W. W. Shaver, Corning Glass Works, Corning, N. Y., discussed "Windows and their Relation to Air Conditioning." "Thermal Studies Applied to Carbon Dioxide Practice," presented by Doctor Goosmann, concluded the technical business of the meeting.

A dinner dance was held by the society Tuesday evening at College Inn, and on the following day the Engineers' Celebration at Soldiers Field, the Exposition and Power Show, and the Engineers' Banquet at the Stevens Hotel, concluded the Society's official functions.

Contractors Affected by N. Y. Sales Tax

The State of New York recently placed in effect a temporary emergency tax on receipts from the sale of tangible personal property, amounting to 1% of the receipts. Heating contractors are affected, inasmuch as material they sell at a fixed price is being sold to the final consumer and therefore taxable. Material the contractor buys to be used as part of a lump sum contract, however, is taxed when sold to the contractor, for such material is interpreted as being consumed by the contractor.

Regulations covering the tax, with explanatory questions and answers, have been published in pamphlet form by the State Department of Taxation and Finance, and can be obtained on application from the offices at Albany, or branches at New York, Brooklyn, Utica, Syracuse, Rochester, and Buffalo.

A. S. M. E. Sponsors Many Sessions at Chicago

Engineering Week, celebrated in Chicago June 25-30, was the occasion for 20 of America's most important scientific and engineering groups to meet in that city to hold 70 technical sessions at which some 200 papers were presented. Meetings of the American Society of Mechanical Engineers, some of which were held independently, and some in conjunction with other professional groups, extended over the entire week, and a wide variety of topics, both technical and economic, came up for discussion at the gatherings of the various sections.

Dust removal and smoke abatement were dealt with in four papers, presented under the auspices of the Process Industries Committee, and the Fuels Division. J. M. DallaValle, assistant sanitary engineer, Public Health Service, Washington, discussed "Characteristics and Mitigation of Industrial Dusts."

At the session devoted to smoke abatement, Arthur C. Stern, research instructor, Stevens Institute of Technology, Hoboken, N. J., discussed the results of a study of the available methods for measuring cinder and fly ash in a paper entitled, "The Measurement of Properties of Cinders and Fly Ash." Methods investigated included filtration, centrifugal sampling, electric precipitation, and the impinger method. The author concludes that the cyclone method is the most useful for general test work. He also found that boiler outlet cinder dust loading increased rapidly as the rate of burning coal increased, but that the rate of fly ash loading increased very little as the combustion rate increased.

H. J. Johnstone, department of chemistry, University of Illinois, presented "Progress in Removal of Sulphur Compounds from Waste Gases," in which the types of washers are compared, and the use of such catalysts as manganese and iron in the water to increase the solubility of sulphur dioxide was discussed. The concluding paper of the symposium was "The Human Side of Smoke Abatement," by William G. Christy, Department of Smoke Regulation, Hudson County, N. J.

Fuel Oil Standards Revised

A six-page pamphlet entitled "Fuel Oils" and sub-titled "Commercial Standard CS12-33" has recently been issued by the Bureau of Standards. It gives in full the latest revision of the commercial standards covering the six grades of fuel oil in common use. Upon being made effective May 1 last, these new standards took the place of the older ones described as CS12-29.

The new standard was adopted and published under the usual regulations of the Bureau of Standards in such matters. No changes have been made in the fundamental and physical qualities of the six oils, whose numbering under the old standards has come into wide use during the last few years. The main change is that the words "commercial" and "industrial" are not used in describing these oils. They are simply known as Nos. 1, 2, 3, etc., without consideration as to whether their use is with domestic or industrial burners. Changes in the words used to describe them have also been made and tend to clarify the meaning of the kind of oil mentioned.

Copies of the paper may be obtained by addressing the Superintendent of Documents, Washington, D. C.; price 5 cents.

Regulator Companies Consolidate

The Mason Regulator Co., Boston, and the Neilan Co., Ltd., Los Angeles, subsidiary of the Mason Company, have consolidated. The name of the new company is the Mason-Neilan Regulator Company. The engineering, manufacturing, and sales departments of the two companies have been combined at 1190 Adams St., Boston. F. Kenneth Morrison will be sales manager, and Douglas H. Annin, chief engineer, of the new company.

Air Filter Manufacturers Organize

Leading manufacturers of air filters of various kinds met at Detroit during the last week of June and formed an association named the National Association of Air Filter Manufacturers. The following officers were elected for the ensuing year; President, J. L. Harpham, Independent Air Filter Company; vice-president, J. S. Irvine, Owens-Illinois Glass Company; secretary, J. R. McConnell, American Air Fil-

ter Company. The principal matter discussed was the Industrial Recovery Act. A tentative code was adopted and preliminary steps taken to comply in every way with the requirements of the Act.

Air Controls Purchases Warm Air Furnace Fan Co.

Air Controls, Inc., Cleveland, division of The Cleveland Heater Company, announces the purchase of The Warm Air Furnace Fan Company.

The new organization, under the direction of A. M. Apmann, of The Cleveland Heater Company, and Marion I. Levy, formerly with the Bishop & Babcock Sales Company, will continue the manufacture of fans and blowers for warm-air heating.

Kollins Forms Refrigeration Company

John A. Kollins, formerly manager and chief engineer of the Pittsburgh Refrigeration Company, announces the incorporation of the Allegheny Refrigeration Engineering Co., 1141 Penn Ave., Pittsburgh, Pa., to specialize in the designing, erecting, and servicing of ice and refrigerating machinery. H. V. S. Goodrich is assistant manager.

Air Conditioning Department of G. E. Moves

The New York offices of the air conditioning department of the General Electric Company have been removed from 120 Broadway to the new G. E. Building at 570 Lexington Avenue.

May Heads Young Heating Division

Young Radiator Co., Racine, Wis., announces the appointment of M. F. May as sales manager of its heating division.

Cosgrove New Head of Committee of Ten

John C. Cosgrove, Johnstown, Pa., president of West Virginia Coal & Coke Company, was elected chairman of the Committee of Ten, Coal & Heating Industries, at the committee's annual meeting, June 15, in the Drake Hotel, Chicago. Mr. Cosgrove is also chairman of the Technical Research Section of the National Coal Association. Re-elected were: L. H. Dayhoff, vice-chairman; Carlyle M. Terry, secretary; Harry M. Kurtz, treasurer; Oliver J. Grimes, managing director, and Marc G. Bluth, assistant secretary-treasurer.

The new board of directors will consist of John C. Cosgrove, J. Harvey Manny, H. M. Hart, Homer R. Linn, and L. H. Dayhoff.

Fire Destroys Oil-Burner Plant

Fire of undetermined origin completely destroyed the factory and equipment of Electrol, Inc., St. Louis, July 8. The company states that deliveries of burners and boiler-burner units will not be affected as there is a large stock on hand in the East. The loss was completely covered by insurance, and arrangements have been made to continue production immediately.

Chase Brass Buys Erskine Radiator

The Chase Brass and Copper Co., Waterbury, Conn., has acquired the assets of the Erskine Copper Radiator Corp., New York, for which it has been manufacturing several items for the last two years. A department has been established under the name of Erskine Radiator Division of the Chase Brass and Copper Company to handle the manufacturing and sales of the acquired property.

James D. Erskine, who has been president of the Erskine Company, will be in charge of the sales of the Erskine division in the East. Chase Brass and Copper is controlled by Chase Companies, Inc., a subsidiary of the Kennecott Copper Corporation.

COMING EVENTS

SEPTEMBER 25-29, 1933. Fifteenth Annual Convention of the American Gas Association, to be held in Chicago.

FEBRUARY 5-9, 1934. Third International Heating and Ventilating Exposition, to be held in the Grand Central Palace, New York.

News of the Month

Committee of Ten Report Deals with Heat Service Plans

Miscellaneous Report No. 7, "Heat Service Plans," issued by the Committee of Ten—Coal and Heating Industries, 307 North Michigan Ave., Chicago, outlines the various arrangements for relieving the consumer of labor and responsibilities in the operation of his heating plant, as put into effect by representative coal dealers in a number of states. When ordered singly or in small quantities, the bulletin is priced at 20 cents, with special rates for quantity orders on inquiry.

John Edward Ercanbrack

John Edward Ercanbrack, chief engineer of Bell & Gossett Co., 3000 Wallace St., Chicago, died unexpectedly at his home in Chicago June 8. Born in Woodstock, Ill., Mr. Ercanbrack was 60 years of age. He is survived by his mother and wife.

Mr. Ercanbrack was associated with the plumbing and heating industry for over 40 years. He was one of the originators of the indirect domestic water heater system.

NEW CATALOGS

American Radiator and Standard Sanitary Corp., 40 West 40th St., New York, has issued a booklet, "Romance of Air," in which the subject of air conditioning is comprehensively discussed in a popular, non-technical manner. Equipment is described and illustrated. Thirty pages, 5½ in. by 8½ in.

Buffalo Forge Co., Buffalo, N. Y., has issued Bulletin No. 2904, describing and illustrating its line of unit coolers and conditioners. Dimensions, capacities, and other engineering data are included. Standard size, 4 pages.

Bright Spots in the News of the Month

Employment Rises in June

Employment in plants manufacturing steam and hot water heating apparatus rose from 36.7 in May to 40.0 in June, according to figures made public by Secretary Perkins of the Department of Labor July 19. The figures are in per cent of the number employed in 1926. During the same period payrolls rose from 21.8 to 25.1.

Johns-Manville and Bohn Show Profit

Johns-Manville Corporation and subsidiaries report a net profit of $92,204 for the quarter ended June 30, as compared with a net loss of $602,270 in the same quarter last year.

Bohn Aluminum and Brass Corporation announces a net profit of $509,302 for the quarter ended June 30, as compared with a net loss of $763 in the corresponding quarter last year.

Building Jobs Increase in Pennsylvania

Employment in construction work in Pennsylvania increased 10.6% in June compared with May, according to the State Labor and Industry Department at Harrisburg.

New Survey Reveals Increased Activity in Real Estate Market

Increased activity in the real estate market is indicated in nearly 40% of the reports received by the National Association of Real Estate Boards in its semi-annual survey of 245 major cities. This is the first survey to show a predominating upward trend since June, 1929. Only 35% classified the market as less active than a year ago, and 27% list it as unchanged. The new survey reveals that the strongest pickup so far has been in cities with populations ranging between 200,000 and 500,000.

Real estate prices continue at levels lower than those of a year ago in 78% of the cities reporting, while 10% note an upward trend. In 90% of the cities investigated, a shortage of money for real estate loans continues, and nearly 25% report rising interest rates on mortgages, 65% say rates are steady, and 11% record falling rates. An under supply of one-family dwellings is indicated in 12% of the cities reporting.

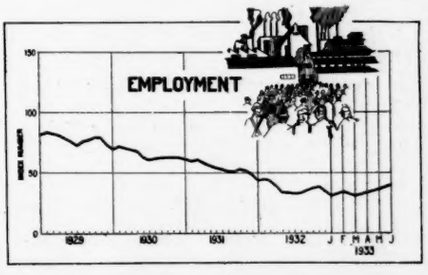
Radiator Shipments up 33%

Shipments of cast-iron radiators increased 33% in May as compared with April, from 1605 thousand square feet in April to 2133 thousand square feet in May. The increase exceeded the normal seasonal rise of 25.7%. Shipments during May were the largest so far in 1933, but are below the corresponding month in 1932.

Convection-type radiator orders rose sharply from 158 thousand square feet in April to 309 thousand in May, an increase of nearly 96%. The May orders exceeded those in May, 1932, by 7%.

Employment Rising in New York State

Employment in manufacturing plants in New York State making steam and hot water heating apparatus rose from 22.6 in April to 23.9 in May, the figures being per cent of the 1925-27 average. The index in May, 1932, stood at 13.1.



Employment in the steamfittings manufacturing industries has trended steadily upward since last May, as shown above.

The May total of building permits in New York was 16% greater than any reported so far this year. The number of employes engaged in building construction consequently showed an increase as compared with April, but the number employed by sub-contractors, including heating and piping contractors, decreased.

Wholesale Prices Rise

Largely due to the advance in price of boilers and radiators, the wholesale price index of heating and plumbing materials, as compiled by the Department of Labor, increased from 61.3 in May to 67.4 in June. The index is in percentage of the 1926 average price.

The index comprising all building materials rose during the same period from 71.4 to 74.7, while prices of all commodities increased from 62.7 to 65.0.

June Building Contracts Up 34%

Building contracts of all types awarded in the 37 states east of the Rocky Mountains during June totaled $103 million, a gain of nearly 34% over the total of $77 million reported for May, according to figures compiled by the F. W. Dodge Corporation. The June figure was slightly below the same month last year, which showed $113 million.

In last month's work was $74 million in privately financed work and $29 million for public undertakings. The private work was well ahead of the May figure of $53 million and of the same month in 1932, which showed $49 million in that classification.

Residential building awards last month totaled $28 million, against $27 million for May and only $23 million for June, 1932. Non-residential awards amounted to $51 million, as compared with $32 million in May and $40 million for June last year.

News of the Month

Commodore Heaters Corp., 11 West 42nd St., New York, has issued Bulletin 6, "Convectofin Takes the Place of Radiators," explaining the principle of convection heating, and describing construction and installation of Convectofin built-in heaters. Standard size, 8 pages.

C. A. Dunham Co., 450 East Ohio St., Chicago, has issued Bulletin 115 describing the Dunham differential vacuum heating system with average temperature control. Standard size, 15 pages.

McLeod & Henry Co., Troy. N. Y., has published Bulletin F-56 describing its Steel Mixture Oil brand firebrick for oil-fired furnaces, Carbex silicon-carbide brick for boiler, stoker, and industrial furnace linings, and high-temperature fire cements, furnace linings, and arches; 16 pages, 3 in. x 6 in.

The Mercoid Corp., 4201 Belmont Ave., Chicago, has issued catalog G-28 describing the complete line of Mercoid controls for heating, air conditioning, refrigeration, and industrial applications. Apparatus is explained and illustrated and prices and operating characteristics listed. Standard size, 58 pages.

Mundet Cork Corp., 450 Seventh Ave., New York, has issued a price bulletin covering Jointite cork coverings for low temperature pipe lines. Specifications and engineering data are also included. Standard size, 16 pages.

B. F. Sturtevant Co., Hyde Park, Boston, Mass., has issued Catalog No. 392 describing and illustrating a number of industrial and commercial applications of Sturtevant air conditioning equipment. Standard size, 18 pages.

Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo., has published Part 5A of Bulletin 167, describing and illustrating its line of long-hour duty split phase motors. Standard size, 6 pages.

Ward Leonard Electric Co., Mount Vernon, N. Y., has issued Bulletins 1103, 1104, and 1105 describing Vitrohm rheostats and Adjustats for fractional horsepower motor control. Standard size, 3 pages.

NIRA Codes Make Progress

(Concluded from page 33)

National Association of Steam and Fluid Specialty Manufacturers.
Stoker Manufacturers Association.
The Institute of Boiler and Radiator Manufacturers.
Insulation Board Institute.
The Cork Insulation Manufacturers Association.
Refrigerating Machinery Association.
Associated Equipment Distributors.
National Warm Air Heating and Air Conditioning Association.
Steel Heating Boiler Institute.
National Association of Ice Industries.
American Gas Association.
Steam Heating Equipment Manufacturers Association.
Hydraulic Society.
National Association of Air Filter Manufacturers.
Valve and Fittings Institute.
Concealed Heater Manufacturers Association.

None of these codes has been made public and their exact provisions are not available as we go to press. Five other trade groups within the industry should reasonably be expected to prepare codes but confirmation of this fact is lacking.

Altogether, then, there are at least 20 separate and independent codes in existence or in preparation. Their coordination will be a big job and the next few months should bring forth interesting news of their progress through the NIRA machinery.

Code for Heating Contractors

Important provisions of the code adopted by the Heating, Piping and Air Conditioning Contractors National Association, Incorporated, follow: 8 hr. constitute a maximum working day for journeymen steamfitters, helpers, apprentices, and laborers; 150 hr. represents total number of hours any man may work in any four consecutive weeks, but with the right to work a total of 40 hr. each week for any six weeks between October 1 and March 1; minimum wages for steamfitters ranging between $0.60 and $1.00 per hr., depending upon the size of the community.

Contractors agree to refrain from inducing a breach of contract between competitor and his customer; rebates, secret refunds, unearned discounts, etc., may not be made; contractors to refrain from selling labor or materials at or below cost; blanket orders or future delivery contracts for the same material for the same job must not be made; contractors will not undertake to complete a job temporarily abandoned by another contractor because of non-payment of amounts properly due.

25 Years Ago in

The Heating Ventilating Magazine

AUGUST, 1908

"*ANOTHER PHASE* of the heating business which is a frequent source of annoyance and error is the relation of the heating engineer or the contractor installing such work to the architect. The house plans are usually made without consideration of the heating; the heating plans are then supposed to be made to fit the house plans.

"Now, what the average architect does not know about the heating business—— etc., etc."—*From an article by Prof. J. D. Hoffman, Purdue University.*

D. G. C. VALVE CO., New York, has been capitalized for $300,000 to manufacture the D. G. C. valve for steam radiators. President, John H. Eastwood; vice-president and general manager, Albert A. Cryer; second vice-president, George T. Casebolt; treasurer, George Livingstone; secretary, Andrew G. Paul.

AMERICAN RADIATOR CO., Chicago, announces that it has purchased the plant, patents, and patterns of the A. A. Griffing Iron Co., Jersey City, bankrupt.

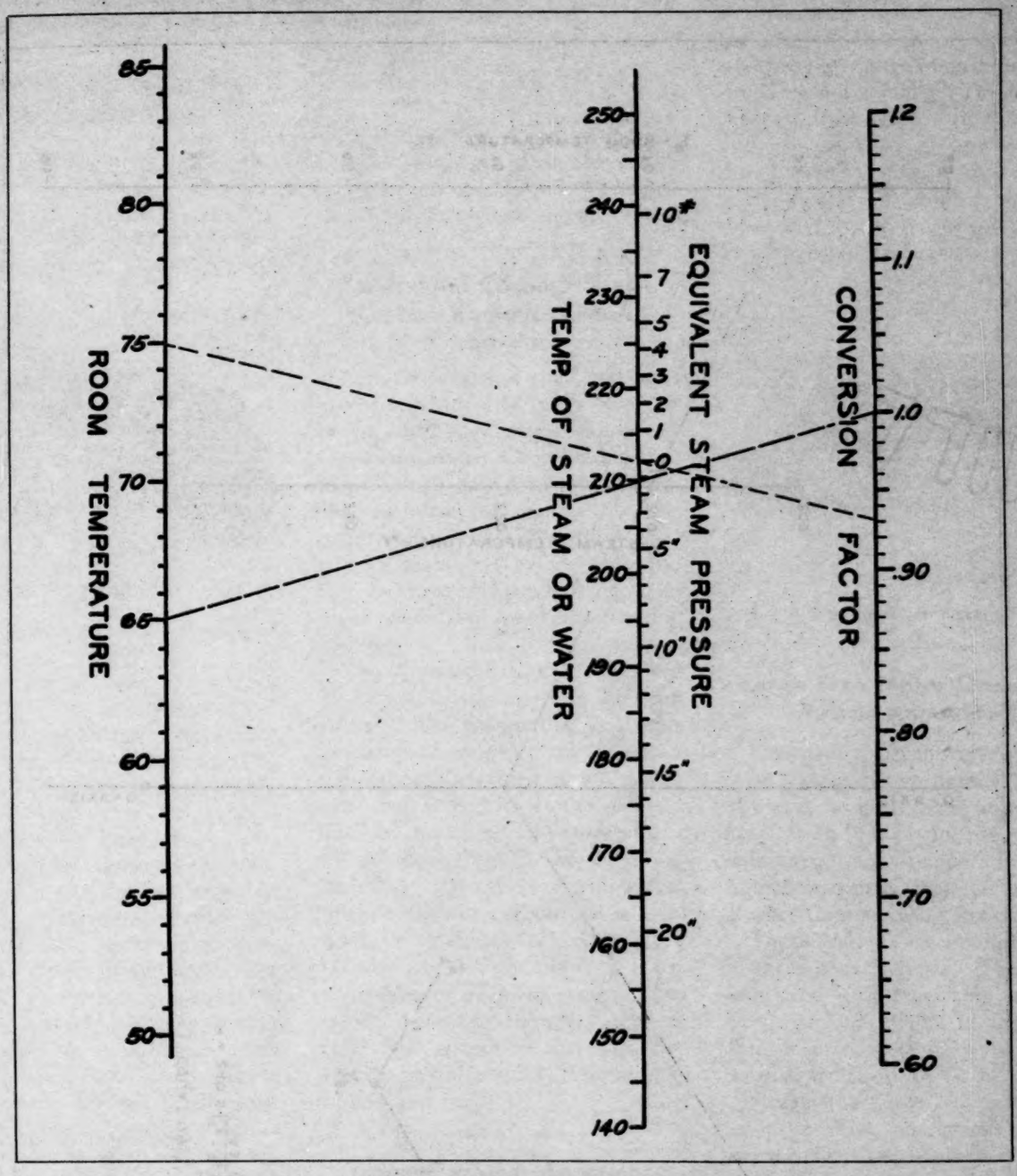
AMERICAN DISTRICT STEAM CO., Lockport, N. Y., suffered a loss by fire of $115,000, July 24, when its main building containing $40,000 worth of special equipment was practically destroyed by the flames. The loss is covered by insurance, and the company will rebuild immediately.

SPENCER HEATER CO., Scranton, Pa., manufacturer of steam and hot water boilers and radiators, has been capitalized at $200,000 and is authorized to operate in Illinois with a capital of $11,000.

A PAPER presented at the Detroit meeting, A.S.M.E., June, 1908, by William H. Bryan, advocates the identification of the various systems of piping in a power plant by painting them different colors to conform to a standard code.

THE EXISTENCE of a law in New York State, adopted the preceding fall, requiring provision of proper and sufficient ventilation in factories, proved a surprise to most of the members of the A.S.H.V.E., assembled for its 12th semi-annual meeting, Detroit, July 24-25. It was unanimously agreed to support Chief Factory Inspector Walling in his enforcement of the law, and it was voted to add to the Committee on Compulsory Legislation the names of several New York State members whose duty it would be to aid the society in enforcing the law and in combating any efforts looking toward its repeal.

RADIATOR EMISSION UNDER OFF-STANDARD CONDITIONS



The chart shown above, designed by Louis Culkin,and that on the reverse side of this sheet, designed by J. N. Arnold, are for determining the heat emission of radiators when the steam temperature is other than 212° and the room temperature is other than 70°. As an example of the use of the above chart, assume that we have 212 lb. steam, but that the radiator is to be in a room at 75°. What will be the heat emission of the radiator? Draw a line through 75 on the left-hand scale and through 212 on the center scale and we find a conversion factor of 0.93. The standard heat emission of a square foot of radiator is 240. 240 × 0.93 = 223 B.t.u. per sq. ft.

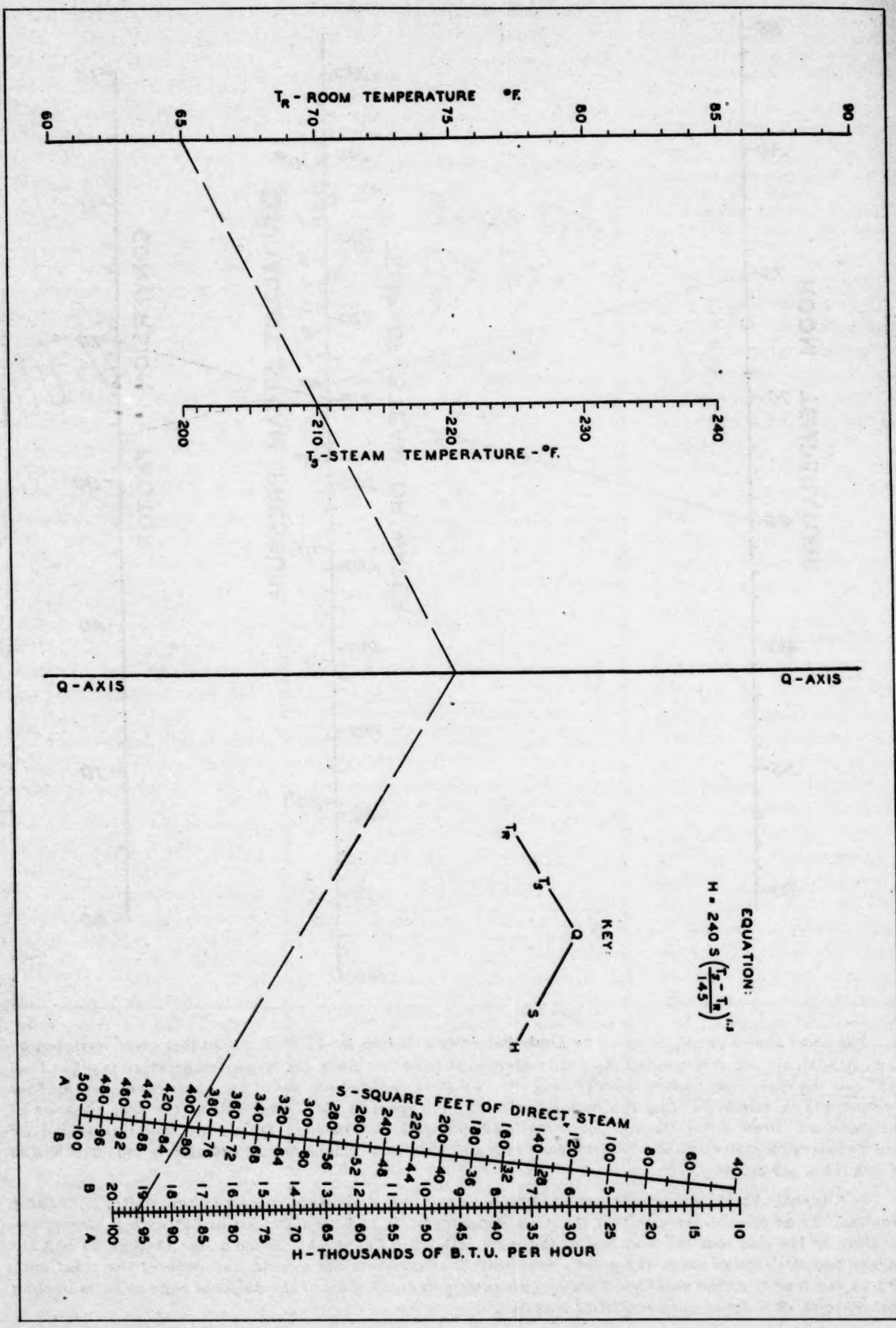
The Arnold chart is used for the same purpose except that it gives the answer in square feet of radiator required. As an example assume that the room temperature is to be maintained at 65° with a steam temperature of 210, and that the heat loss of the room is19,200 B.t.u. per hr. Draw a line through 65 and 210 on the two left scales; locate the point where this line intersects the Q axis, and connect the point with 19.2 on the B scale of the right-hand scale. This intersects the B scale of the diagonal scale at 80, indicating that 80 sq ft. of radiator surface will be required.

(See other side)

H. & V.'s REFERENCE DATA—15

RADIATOR EMISSION UNDER OFF-STANDARD CONDITIONS

(See other side for explanation)

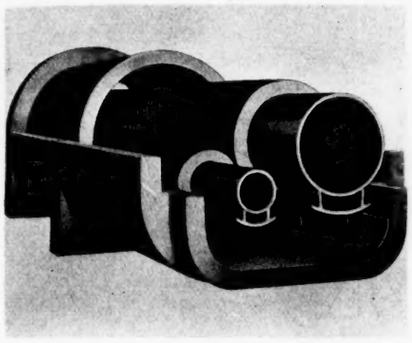


H. & V.'s REFERENCE DATA—16

New Equipment

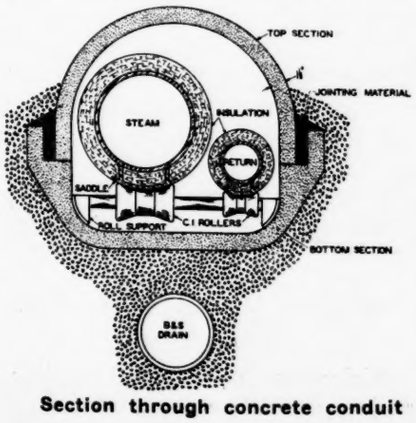
Precast Concrete Conduit for Underground Pipe

Precast reinforced concrete conduit for underground pipe lines has been placed on the market by Underground Steam Construction Co., 75 Pitts St., Boston. The manufacturer cites for it many advantages in the way of strength, capacity, and economy, and points to its simplicity and flexibility of installation. The conduit is manufactured in the locality in which it is to be used, of local materials and by local labor.



Uscco precast concrete conduit

The complete assembly is composed of only two sections, tops and bottoms, easily distinguishable from one another and requiring no special sections for pipe supports. The shape of the section is such as to give 12% greater area than circular conduit of similar diameter, with the additional space at the bottom where room is required for drainage and pipe supports. Uscco conduit is manufactured in 4-ft. lengths, and bell and spigot joints, sealed with Portland cement or any patented joint compound, are employed to form the conduit into an integral unit.



Section through concrete conduit

Pipe is carried on cast-iron rollers and supports, designed to be firmly and permanently inserted anywhere throughout the conduit.

Activated Coconut Shell Carbon Removes Odors from Air

Activated coconut shell carbon is used for removal of odors from air in an odor filter manufactured by Consolidated Air Conditioning Co., 942 Chrysler Building, New York. The manufacturer claims for this material maximum absorptive capacity, a high degree of retentivity, and sufficient structural strength to resist crumbling in transportation and use.

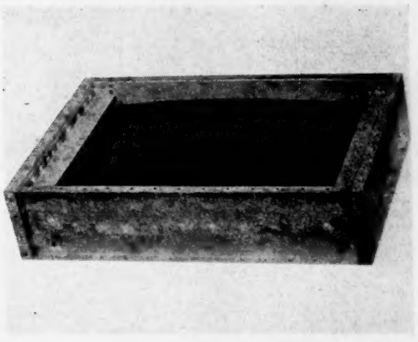
The activated carbon is contained in unit cells mounted in an iron cabinet. The framework and grids are made of welded black iron, and the carbon is retained by a 22-mesh rustproof steel wire cloth, securely fixed to the frame . The overall dimensions of the cell are 20 in × 20 in. × 2½ in., and the actual thickness of the carbon bed is 1 in. Each cell handles 125 c.f.m. at a velocity of 54 f.p.m. with a static resistance of 5 in. of water. The standard cabinet accommodates four cells, but assemblies to meet any specific requirements can be designed and built.

Young Radiator Announces Improved Blast Heaters

A revised line of non-ferrous heat transfer surfaces for blast heaters and air cooling applications, has been placed on the market by Young Radiator Co., Racine, Wis. They are available in 45 sizes to meet all heating and constructional requirements, and can be furnished for high-pressure work.

Fins are bonded to the round copper tubes by a patented process, giving perfect heat conduction. Tubes are rolled out over the header, and ferrules are driven in to make the joint fast. These ferrules serve as orifices in the supply end, and are made with the same inside diameter as the tube on the return end, affording free discharge of condensate whether the heater be installed vertically or horizontally. The headers are cast from electric furnace iron, and are designed to provide even distribution of steam to the tubes.

Heaters are assembled with the tubes slightly curved to compensate for expansion and contraction.

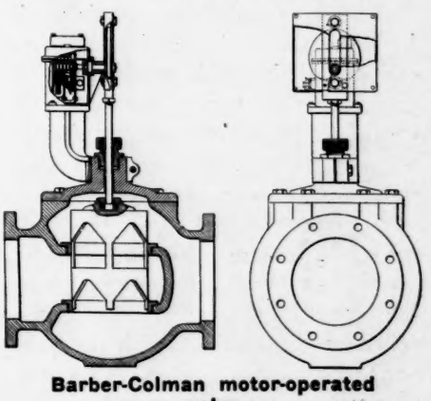


Young blast heater

Large Size Motor-Operated Valves Announced

Electrically-driven valves for remote automatic or manual control of steam in sizes larger than 2 in., have been added to the line of equipment for temperature and humidity control manufactured by Barber-Colman Co., Rockford, Ill.

These valves are manufactured in three general types. The single-seat type with renewable composition disc is available in sizes from 2 in. to 6 in., and will handle pressures from 80 lb. to 90 lb., depending upon the size. It is made with either positive or reversing motor drive. The semi-balanced bronze disc type is made with vee-port disc in 2 in. to 4 in. sizes, and with standard disc in the 5 in., 6 in., and 8 in.

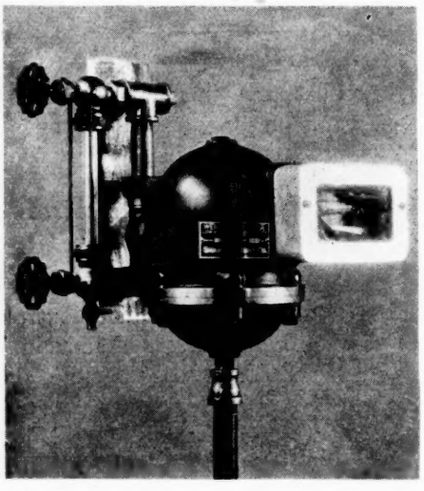


Barber-Colman motor-operated valve

sizes, either positive or reversing, for 125-lb. pressure. The largest valve, of the full-balanced vee-port piston disc type, is available in sizes from 5 in. to 12 in. with reversing operators only. This valve will handle up to 125-lb. pressure.

Low Water Cut-Off Has Single Connection to Boiler

Shand and Jurs Co., Carlton and 8th Streets, Berkeley, Calif., has announced the Webber No-Surge low water boiler safety control, adaptable to any type of heating boiler.



Webber No-Surge low water control

It is designed for direct connection or gauge glass mounting, and is available with mercury switch, with or without automatic reset, or with a gas valve, and can be furnished to operate in conjunction with a pressurestat. The manufacturer states that it can be installed in less than ½ hr. without interruption of the heating service.

A single 1-in. connection is made between the boiler and the safety control. This single connection, by trapping the water in the float chamber, prevents false tripping of the switch or valve, and prevents unnecessary wear on the moving parts, since the water in the float chamber does not fluctuate rapidly up and down with the ebullition of the water in the boiler. Since the control communicates with the boiler through a single connection, circulation of water from the boiler through the device cannot take place, and the connection will not become clogged with mud and scale carried in the boiler water.

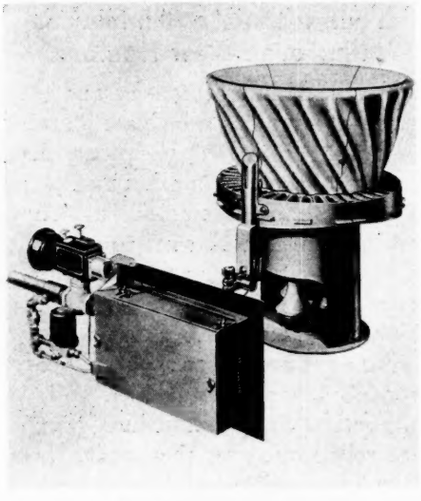
The safety can be used for water level control of boilers, starting and stopping a water pump to maintain a uniform level within a range of approximately 1 in.

A. G. P. Introduces Conversion Burner

American Gas Products Corp., Division of American Radiator Co., 40 West 40th St., New York, has announced the Ideal gas convertor in three sizes suitable for residential and small commercial requirements. It is designed for installation in boilers or furnaces with round combustion chambers.

Burner is ring shaped, and is surmounted by a refractory baffle having helical ribs which impart a swirling motion to the hot gases of combustion. A throttling control valve, operating in conjunction with a boiler or furnace regulator acts to gradually reduce the flow of gas to the burner when the temperature for which the pressure or temperature regulator is set is approached. This pressure or temperature is accurately maintained until the room thermostat completely shuts off the burner. A thermostatic pilot, operating on the vapor tension principle used on all Ideal gas-fired boilers, controls the operation of the burner, and a gas-burning pilot provides for ignition.

Ideal gas convertors are available in three sizes, adaptable to firepots from 16 in. to 30 in. in diameter.



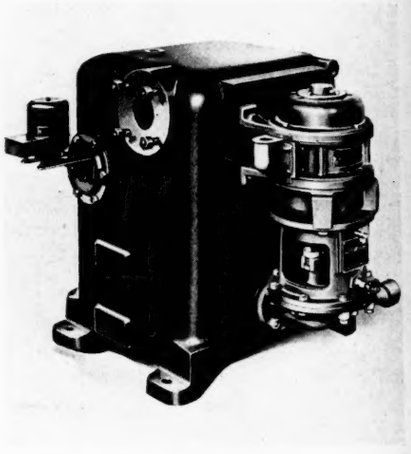
Ideal gas convertor

Input rates are 200,000, 300,000, and 400,000 B.t.u. per hr., respectively.

Ingersoll-Rand Manufacturers Condensation Return Units

A complete line of Cameron Motorpump condensation return units is being manufactured by Ingersoll-Rand Co., Phillipsburg, N. J. They are available in capacities to handle from 1500 sq. ft. to 30,000 sq. ft. of radiating surface.

Pump is the company's standard close-coupled pump with G.E. motor drive, mounted on the side of the condensation reservoir. The reservoir consists of a 15-gal., 30-gal., or 60-gal. tank, depending upon the extent of the system to be served. The units are to be had with either single or duplicate pumps.



Cameron Motorpump condensation return unit

Fan-Cooled Motor for Stoker Drive

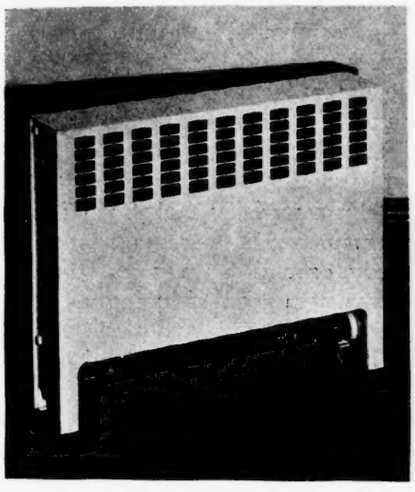
A condenser-start, induction-run single-phase motor with characteristics suitable for stoker drive, has been placed on the market by The Leland Electric Co., Dayton, Ohio. The motor is totally enclosed and is equipped with an external cooling fan to permit continuous duty operation without excessive temperature rise. It is available in ⅛ hp., 1/6 hp., and ¼ hp. capacities.

Richmond Develops Cast-Iron Convector

Richvar convector-type cast-iron radiators have been placed on the

market by Richmond Radiator Co., Inc., 1480 Broadway, New York. These radiators are compact, weighing less and occupying less space than standard radiators of corresponding surface, and may be installed recessed, wall mounted, or standing.

Sections are assembled with malleable push nipples, with wrought-iron tie rods passing directly through the nipple ports. The cored sections are flat, having vertical fins which curve outward at the top to give a horizontal air discharge, and a flange extends around the outer rim of each section excepting at the discharge opening. The sections are ground accurately to a length of 2 in. so that fins and flanges fit snugly



Richvar radiator

together to form vertical flue ways for the heated air and to give a smooth and easily cleaned exterior radiating surface.

Richvar radiators are available in the 20-in. height only, and in lengths in multiples of 2 in. Catalog ratings are given as equivalent to 2.15 sq. ft. and 3.25 sq. ft. of direct radiating surface for the 5 in. and the 7½ in. widths, respectively.

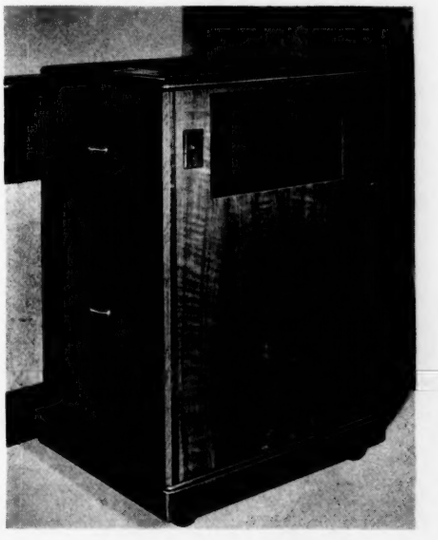
New Strang Conditioner Removes Heat to Outside Air

Utilizing a new method for transferring heat from the refrigerant condenser coils to the outside air, the Strang room cooler and air conditioner, recently-announced product of The Strang Air Conditioning Corp., Kansas City, Mo., is a self-contained portable unit. These conditioners are available in a series of models and capacities to carry various loads, and meet space requirements. It may be used to circulate washed and humidified air during the heating season.

A motor-driven compressor, mounted in the base of the cabinet, cools and dehumidifies the recirculated room air by means of a direct-expansion cooling coil. A motor-driven fan draws the room air into the cabinet at the top rear, and after passing it over the coil, discharges it through louvers in the front of the unit.

The condenser, consisting of 40 ft. of ½-in. copper tubing, is submerged in a tank containing approximately 6 gal. of water. This water is cooled by evaporation into the outside air, which is drawn in through a connection easily made to a convenient window, circulated through the evaporating chamber, and discharged outside the conditioned space. A small motor-driven agitator, located in the evaporating chamber, accelerates the evaporative cooling process, and the outside cooling air, which at no time comes in contact with or mixes with the room air, is circulated by a blower-type fan, belt-driven from the main compressor motor. The proper water level is maintained in the evaporating chamber by a float-operated valve which admits make-up water as it is evaporated. No other water is required for the operation of the unit.

A window panel, of 18-gauge alloy steel, finished to match the cabinet, is furnished with each unit, together with two lengths of flexible tubing for outside air connection.

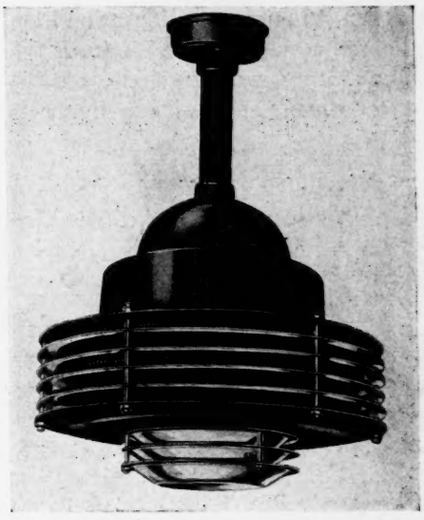


Strang room cooler

Room Cooler Hung from Ceiling

Trupar Manufacturing Co., Dayton, Ohio, is marketing the Mayflower room cooler for ceiling suspension. It is designated for use in stores, shops, restaurants, offices, and other commercial establishments. The manufacturer points out that the ceiling mounting saves valuable floor space and claims that a more natural circulation of cooled air without drafts results.

A compact 1/20-hp. motor-driven fan draws air in through the louvers at the bottom and passes it over the spiral copper finned cooling coil, discharging it back into the room in a horizontal direction. Water condensed from the air is removed from a small reservoir into which it falls by a bronze displacement pump driven through a stainless steel shaft. Refrigeration is supplied by a Mayflower compressor, located in basement or closet. The frame of the room cooler is made from rust-resisting coated steel, and all moving parts are carried on soft resilient rubber.



Trupar ceiling-suspended room cooler

Humidifying Well Built into Cast-Iron Radiator

Direct cast-iron radiators with a built-in humidifying device are be-

ing marketed in standard dimensions and capacities by Crouse & Pope Foundry Corp., Auburn, N. Y., under the name Humi-Rad.

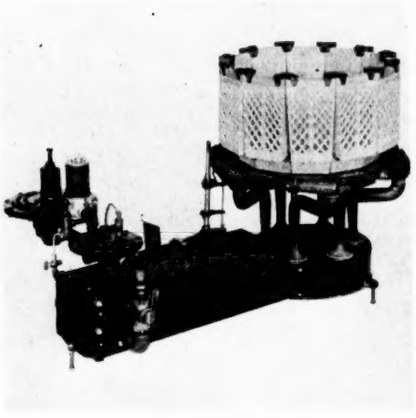
Radiators are of conventional design having a smooth continuous water channel 2 in. wide and ½ in. deep cast into the top and extending the full length of the radiator. Water is conveyed to the humidifying well through a ⅛-in. pipe or small copper tube, and flow is regulated by a readily accessible valve, located beneath the aluminum grille covering the well. A tapping is provided for a ⅛-in. overflow pipe. When used in steam systems, a special valve is supplied which automatically removes condensation from the radiator and delivers it to the humidifying well, making outside water supply and overflow unnecessary.

Conversion Burner Adjustable to All Sizes of Combustion Chamber

A new gas conversion unit, having burners swivel-mounted to permit accurate fitting to all sizes of round firepots, has been placed on the market by the Bryant Heater & Mfg. Co., 17825 St. Clair Ave., Cleveland. The burner is available in five sizes and capacities to meet residential and small commercial requirements.

The refractory radiant is of unusual design, having a grid projecting from its outside surface, designed to emit a high percentage of heat. Burners are of cast iron, having raised, drilled ports arranged to prevent impingement of flame on firepot wall. These burners are supported on movable connections for adjustment to combustion chamber space.

A gas pressure regulator maintains a constant operating pressure of 1½ oz. at the burners, regardless of fluctuations in the street main pressure. The master control is a Bryant snap valve. When in operation, gas pressure on the under side of the diaphragm holds the valve open against gravity. All auxiliary controls, such as room temperature



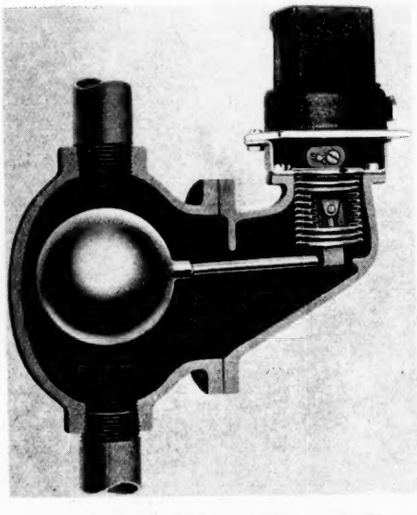
Bryant gas conversion burner

control, pilot control, low water control, etc., operate this main control by admitting gas above the diaphragm, thus equalizing pressure on two sides and permitting gravity to close the valve.

New McDonnell Low Water Cut-off

McDonnell & Miller, Wrigley Building, Chicago, has announced the No. 48 McDonnell low water cut-off recommended by the manufacturer for dependable and inexpensive protection for automatically-fired boilers of any size operating at pressures of 25 lb. and lower. The switch is suitable for use in either 110-volt or 220-volt circuits, and is available with or without manual reset and high voltage alarm.

Switch is actuated by a simple float and lever unit moving on a single bearing mounted outside the steam and water zone. Switch chamber and working parts are sealed from the float chamber by a genuine sylphon bellows, and limit stops prevent the float from overriding and minimize the movement of the bellows. A snap-action make and break device prevents arcing and burning, and wiping action maintains clean and bright contact points.



McDonnell low water cut-off

This low water cut-off can be furnished with a second set of high voltage control points which closes an alarm circuit when the burner or stoker is shut down by the cut-off.

Pipe Compounds Permit Easy Detachment

John Sunshine Chemical Co., Inc., 604 West Lake St., Chicago, is marketing Mitee prepared pipe joint compound for use on steam, water, gas, and ammonia piping. The manufacturer recommends it as suitable for use on brass, and states that it may also be used on bolts and studs.

This material is said to seal joints permanently but permits them to be easily opened when necessary. It is free from grit and lumps and possesses lubricating qualities. It remains pliable in the joint indefinitely but will not squeeze out when the joint is turned up.

Gar Wood Announces Water Heater

Gar Wood Boiler Division, Wood Hydraulic Hoist and Body Co., Detroit, has announced an oil-fired commercial water heater for stores, schools, and apartments. The boiler will heat water through a 100° temperature rise at a rate of 200 gal. per hr.

The burner, equipped with electric ignition and automatic operating controls, uses No. 3 fuel oil. The firebox is insulated and lined with refractory material designed to radiate heat back to the flame for efficient high temperature combustion, and hot gases from the firebox are conducted through two passes of flue-ways in the water heater. The size of storage tank required depends upon the hot water demand of the application. Unit is 46½ in. high, 28¼ in. wide, and 64 in long, with the burner.

Stop giving competitors profits from YOUR oil burner sales

You need a complete line to get all the business your customers control

St. Justin's Rectory, Hartford, Conn.

1 **SUCCESS STORY STARTS HERE**

A Nokol model G-2 replaced a burner of another make in the Rectory. Its reliable performance opened the way.

Here's a story with a moral! Rev. Francis P. Nolan had three burners of another make. (No use calling on him, most salesmen would say.) But his burners were old, obsolete. Father Nolan was not satisfied with their present state of operation. So into the Rectory went a Nokol and out came one of the old burners. It worked perfectly. Another Nokol replaced the second old burner in the Convent 8 months later. Six months passed. The last of the three obsolete burners went out and a Nokol was installed in the Sacred Heart Church. Nothing unusual about all this. But wait!

Father Nolan was building a great, new church. It needed a commercial burner. It was a bigger order than all three domestic orders combined. The Petro & Nokol dealer in Hartford got it without asking for it...without competition. Yet without a Petro Model-W to sell, he would have merely sold this order for some competitor who *did* have a commercial burner. The moral? Isn't it about time you stopped giving competitors the big profits from *your* sales?

Petro & Nokol dealers always have a sales advantage. For they have 16 models of 8 types of oil burners to offer, and the Arco-Petro Automatic Boiler in 2 types and 6 sizes for steam, hot water and vapor. Yet their inventory problem is as simple as yours, because the factory can ship practically any oil burner in its line the day the order is received. Ask yourself why you should limit your sales to domestic burners. Your territory may be open.

Petro was selected to present the progress of automatic heat at the Fair.

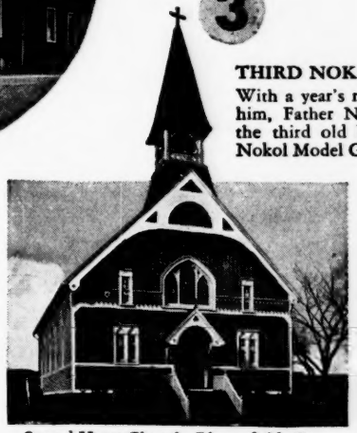
2 St. Justin's Convent

HISTORY REPEATS ITSELF

The first Nokol installation was 8 months old when Father Nolan bought his second G-2 for the Convent, replacing an obsolete burner.

3 **THIRD NOKOL GOES IN**

With a year's record to guide him, Father Nolan replaced the third old burner with a Nokol Model G-1



Sacred Heart Church, Bloomfield, Conn.

St. Mary's Church, Newington, Conn.

5 **AND STILL ANOTHER NOKOL**

The story ends here only because Father Nolan has no more churches. This installation was another Nokol G-2.

WATCH PETRO

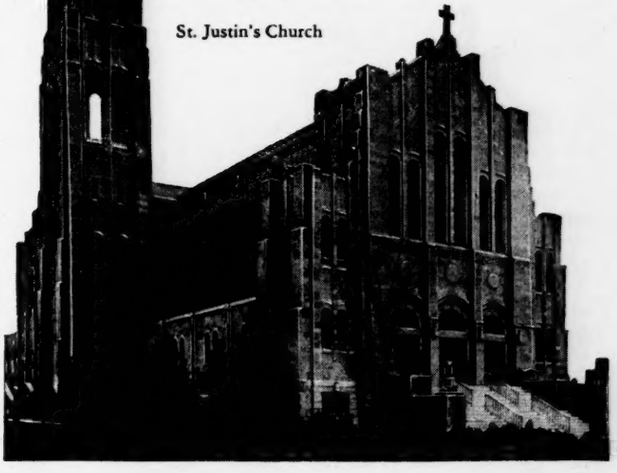
with its complete line!

1. Domestic Oil Burners
2. Arco-Petro Automatic Boilers
3. Industrial Oil Burners
4. Commercial Oil Burners
5. Hot Water Heaters
6. Air Conditioning Devices
7. Pumps, Boiler Controls, etc.
8. Light and Heavy Fuel Oil

4 **AND HERE'S THE CLIMAX**

The Petro-Nokol dealer was handed an order on a silver platter for a Petro fully automatic commercial burner Model W-4 to heat this lovely structure, because his domestic burners had made good and he had *a commercial burner of the same high reputation to sell!*

St. Justin's Church



PETRO-NOKOL

PETROLEUM HEAT & POWER CO., Stamford, Conn.

"World's oldest and largest oil heating organization"

Degree-Day Totals for Season Indicate Higher Fuel Consumption than Last Season

(Percentages below indicate increase or decrease in degree-days for this season, Sept. 1 to May 31, compared with normal)

EAST	
New York	— 10.1%
Philadelphia	— 13.2
Boston	— 13.2
Buffalo	— 7.0
Baltimore	— 10.2
Pittsburgh	— 2.6
MIDDLE WEST	
Chicago	— 3.8%
St. Louis	— 2.9
Kansas City	— 8 1
Minneapolis	+ 0.4
Cincinnati	+ 2.7
Cleveland	— 11.7
Detroit	— 5.8
Indianapolis	— 0.7
Louisville	+ 2.5
Des Moines	+ 0.3
SOUTH	
New Orleans	+ 6.8%
Atlanta	— 2.4
Birmingham	+ 2 6
Memphis	+ 4.1
FAR WEST	
Denver	+ 2.5%
Seattle	+ 0.8
San Francisco	+ 3 6
Los Angeles	+ 0.0

WITH the addition of the June degree-day figures to the previous months of the present heating season (1932-33), the season closes, and the totals for the 24 cities for which HEATING AND VENTILATING compiles records indicate a considerably higher fuel consumption this year than last, but still slightly below normal.

The comparison of each of the cities in percentage deviation from last year is shown to the right, and with normal in the column to the left. The number of degree-days for June, for the present heating season, last season, and normal, and the unit fuel consumption for coal, oil, and gas, are given below. Attention is again called to the necessity of correcting these unit fuel consumptions for efficiency, type of system, heating value of fuel, and for design temperature before applying them.

The eastern cities show, for the season, an increase over last year and a decrease from normal in each case. The middle-west cities also all ran above last year with some above and others below normal. Southern cities show a sharp increase above last year and only small deviations from normal. Far-western cities are about normal, and practically equal to last year; one, Los Angeles, showing for the season's total a figure only one degree-day from normal. Indianapolis, Cincinnati, Baltimore, St. Louis, Kansas City, and Louisville are among the cities showing important gains over last year.

(Percentages below indicate increase or decrease in degree-days for this season, Sept. 1 to May 31, compared with last year)

EAST	
New York	+ 8.2%
Philadelphia	+ 12.2
Boston	+ 1.7
Buffalo	+ 6.4
Baltimore	+ 16.9
Pittsburgh	+ 11.2
MIDDLE WEST	
Chicago	+ 15.7%
St. Louis	+ 27.1
Kansas City	+ 17.0
Minneapolis	+ 13.3
Cincinnati	+ 18.4
Cleveland	+ 8.6
Detroit	+ 12.7
Indianapolis	+ 17.9
Louisville	+ 21.4
Des Moines	+ 14.2
SOUTH	
New Orleans	+ 66.5%
Atlanta	+ 30.2
Birmingham	+ 39.1
Memphis	+ 38.0
FAR WEST	
Denver	+ 7.2%
Seattle	+ 0.4
San Francisco	— 3 0
Los Angeles	— 0.7

Degree-Days and Unit Fuel Consumption—June, 1933

	Atlanta	Baltimore	Birmingham	Boston	Buffalo	Chicago	Cincinnati	Cleveland
Degree-days for June, 1933	—	14	—	53	79	20	19	40
Degree-days, Present Heating Season*	2821	4072	2470	5246	6344	6077	4830	5452
Degree-days, Last Heating Season†	2165	3484	1776	5159	5963	5251	4079	5021
Degree-days, Normal Heating Season‡	2891	4533	2408	6045	6822	6315	4702	6174
Lb. coal per sq. ft. rad., June, 1933	—	0.112	—	0 424	0.632	0.160	0.152	0.320
Gal. oil per sq. ft. rad., June, 1933	—	0.010	—	0.036	0.054	0.014	0.013	0.027
Cu. ft. gas per sq. ft. rad., June, 1933	—	1.34	—	5.09	7.58	1.92	1.82	3.84

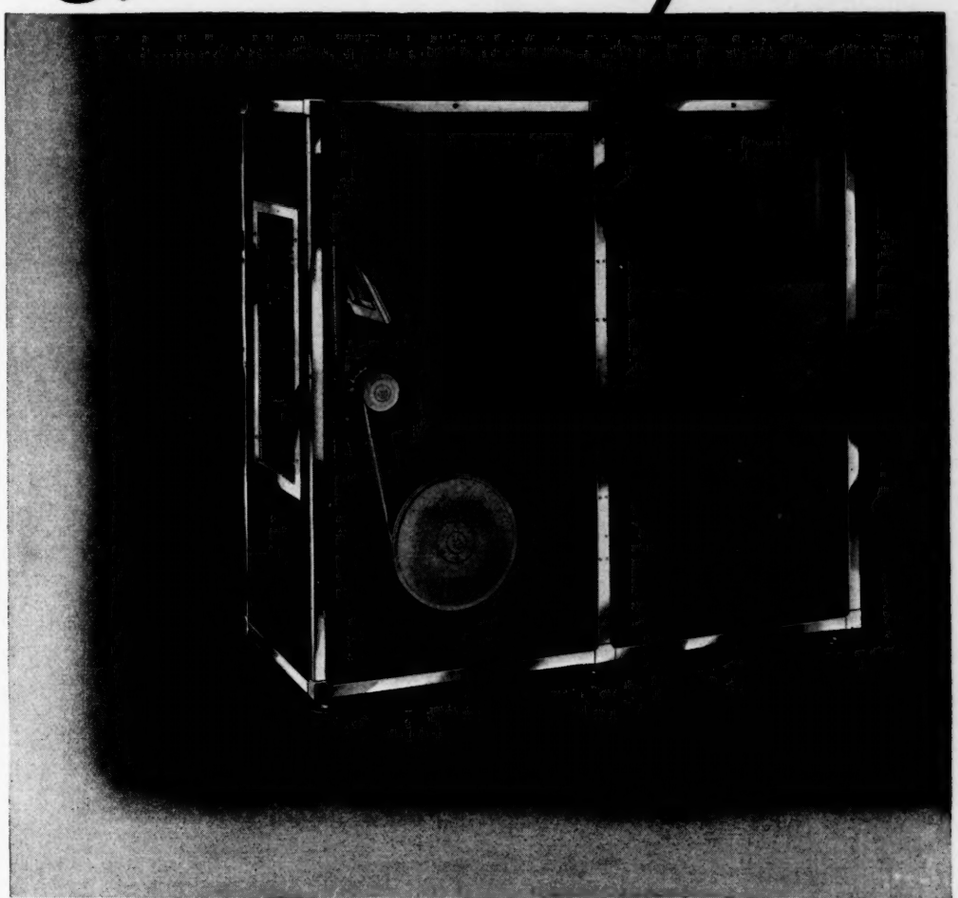
	Denver	Des Moines	Detroit	Indianapolis	Kansas City	Los Angeles	Louisville	Memphis
Degree-days for June, 1933	6	5	29	16	2	42	11	—
Degree-days, Present Heating Season*	6018	6396	6118	5258	4876	1503	4284	3070
Degree-days, Last Heating Season†	5648	5595	5428	4459	4168	1514	3521	2223
Degree-days, Normal Heating Season‡	5873	6373	6494	5297	5302	1504	4180	2950
Lb. coal per sq. ft. rad., June, 1933	0.048	0.040	0.232	0.128	0.016	0 336	0.088	—
Gal. oil per sq. ft. rad., June, 1933	0 004	0.003	0.020	0.011	0.001	0.029	0.008	—
Cu. ft. gas per sq. ft. rad., June, 1933	0.58	0.48	2.78	1.54	0.19	4.03	1.06	—

	Minneapolis	New Orleans	New York	Philadelphia	Pittsburgh	St. Louis	San Francisco	Seattle
Degree-days for June, 1933	12	—	33	15	46	1	222	146
Degree-days, Present Heating Season*	7879	1093	4808	4211	5100	4454	2979	4924
Degree-days, Last Heating Season†	6944	656	4443	3752	4588	3581	3071	4902
Degree-days, Normal Heating Season‡	7851	1023	5348	4855	5235	4585	2876	4884
Lb. coal per sq. ft. rad., June, 1933	0.096	—	0.264	0.120	0.368	0.008	1.776	1.168
Gal. oil per sq. ft. rad., June, 1933	0.008	—	0.023	0.010	0.032	0.001	0.152	0.100
Cu. ft. gas per sq. ft. rad., June, 1933	1.15	—	3.17	1.44	4.42	0.10	21.31	14.02

**Covers period September 1, 1932 to June 30, 1933, inclusive.*
†Covers period September 1, 1931 to June 30, 1932, inclusive.
‡Long-term average, September 1 to June 30.

Fuel consumption figures given above are based on certain conditions, and for other conditions corrections must be made. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operating at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal, 1000 B.t.u. per cu. ft. for gas, and 140,000 B.t.u. per gal. for oil. To correct for other heating values, efficiencies, and design conditions, follow the method explained in the "Heating and Ventilating Degree-Day Handbook."

TONCAN IRON - AN AID TO *Air Conditioning . . .*



Toncan Iron is standard on Air Conditioning Equipment Corporation Units.

Fifteen million dollars is the estimated saving that air conditioning is bringing to industry every year—in rayon plants, cigar factories, paper mills, medical capsule plants, storage plants, wherever temperature and humidity must be kept under close control.

The saving that Toncan Iron is bringing to users of air conditioning equipment is impossible to estimate, but the fact that so many manufacturers of conditioning units use this long-lasting alloy is proof of its merits and its economy.

One striking application of Toncan Iron Sheets is found in the unit illustrated, manufactured by Air Conditioning Equipment Corporation, Milwaukee, Wis. This company has standardized on Toncan Iron because it has found by experience that this alloy of refined iron, copper and molybdenum does two things when used for blowers, filters, humidifiers, ducts and other parts. It lasts longer in the presence of water, spray and moist air because it withstands corrosion, and it gives an added sales feature on account of the reputation that Toncan Iron has built through twenty-five years of service in industry, homes and institutions of every kind.

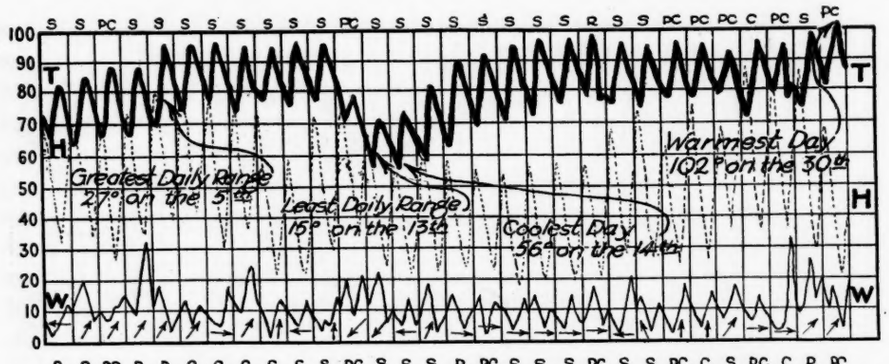
Write for a copy of "The Path to Permanence," illustrating hundreds of uses for this metal that grows old slowly.

TONCAN
COPPER
MOLYB-DEN UM
IRON

REPUBLIC STEEL CORPORATION
GENERAL OFFICES YOUNGSTOWN, OHIO

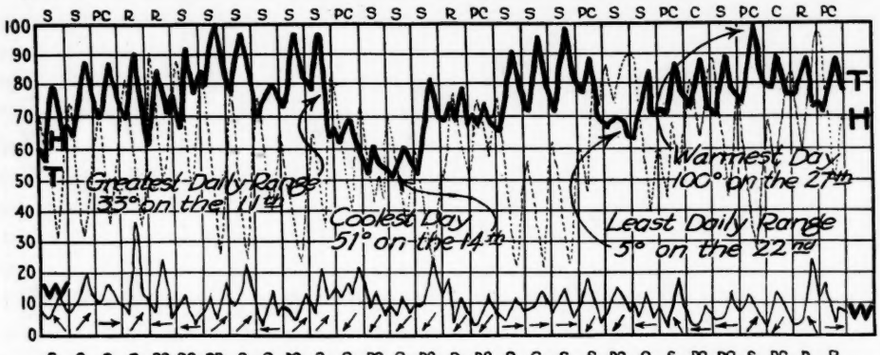
THE WEATHER FOR JUNE, 1933

Plotted from records especially compiled for HEATING AND VENTILATING by the U. S. Weather Bureau. Heavy curves (T), temperatures in deg. F.; dotted lines (H), per cent relative humidity, from readings at 8 a.m., noon, and 8 p.m., except for New York, which shows hourly readings. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions. S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.



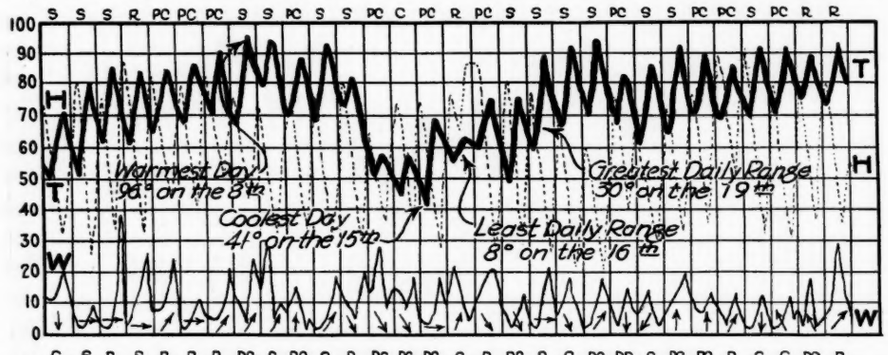
St. Louis

Mean temp. for month, 81.7°; aver. wind velocity, 9.8 m.p.h.; prevailing direction of wind, S.W.



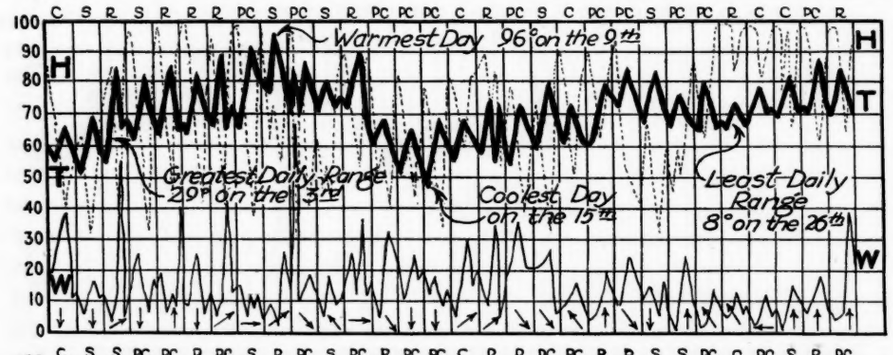
Chicago

Mean temp. for month, 76.2°; aver. wind velocity, 9.3 m.p.h.; prevailing direction of wind, S.W.



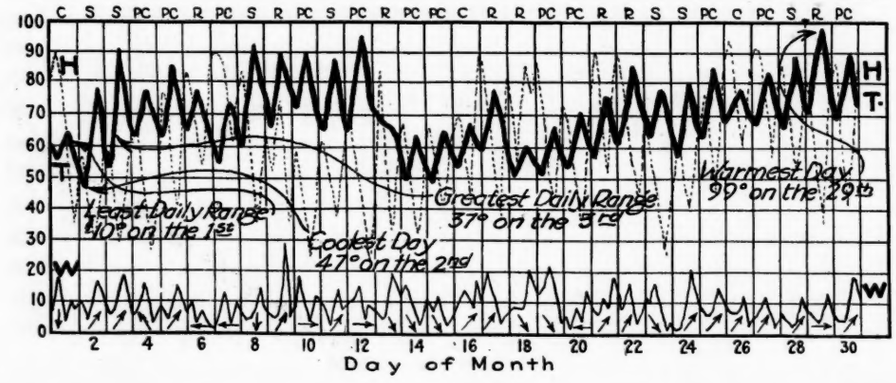
Pittsburgh

Mean temp. for month, 73.3°; aver. wind velocity, 8.8 m.p.h.; prevailing direction of wind, W.



New York

Mean temp. for month, 70.8°; aver. wind velocity, 13.0 m.p.h.; prevailing direction of wind, N.


Warmest Day
99° on the 29th
Greatest Daily Range
37° on the 3rd
Least Daily Range
10° on the 1st
Coolest Day
47° on the 2nd
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

Boston

Mean temp. for month, 69.6°; aver. wind velocity, 8.8 m.p.h.; prevailing direction of wind, S.W.

Flue Gas Facts Show NEED for.. WROUGHT IRON STACKS

BUILDING engineers know from experience that flue gas conductors are subjected to unusually severe corrosion—that the metals ordinarily used are short lived. The reason? Inside, there's the corrosive acid condensate from the gases. Outside, evaporating moisture deposits corrosive salts. The corrosive attack progressing from both surfaces is further aggravated by heat.

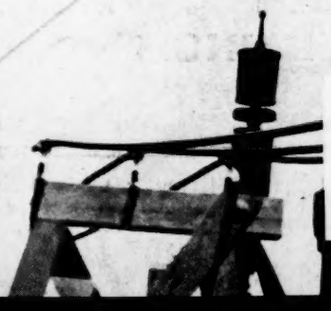
The result, during that period when wrought iron plates and sheets were not available, was that stacks, breechings and ducts did not last long enough.

The use of wrought iron plates and sheets for flue gas conductors is again possible because Byers is now rolling them in a complete range of sizes.

Many leading engineers, after carefully studying flue gas facts and checking up on old wrought iron installations still in service, have concluded that only wrought iron should be specified. Then, too, these engineers know that it is less costly to install wrought iron than to make frequent replacements of less durable metals.

That's the reason the use of Byers Wrought Iron Plates and Sheets for both new installations and replacements of flue gas conductors is steadily increasing.

"Flue Gas Facts," including actual records, photos of recent installations, engineering data and specifications and estimating prices covering Byers Wrought Iron Plates and Sheets, are readily available through any Byers Engineer or our Engineering Service Department. A. M. Byers Company, Pittsburgh, Pa. Established 1864. Pittsburgh, Boston, New York, Philadelphia, Chicago, St. Louis, Houston, Los Angeles.



o and one-half tons of 3/16" and 1/4" Byers ught Iron Plates riveted, recently, into a 30-foot , 5 1/4 feet diameter, for a leading chemical company in New Jersey.

BYERS GENUINE WROUGHT IRON PRODUCTS

PIPE • WELDING FITTINGS • RIVETS • SPECIAL BENDING PIPE • BAR IRON
PLATES • SHEETS • CULVERTS • FORGING BILLETS • STRUCTURALS